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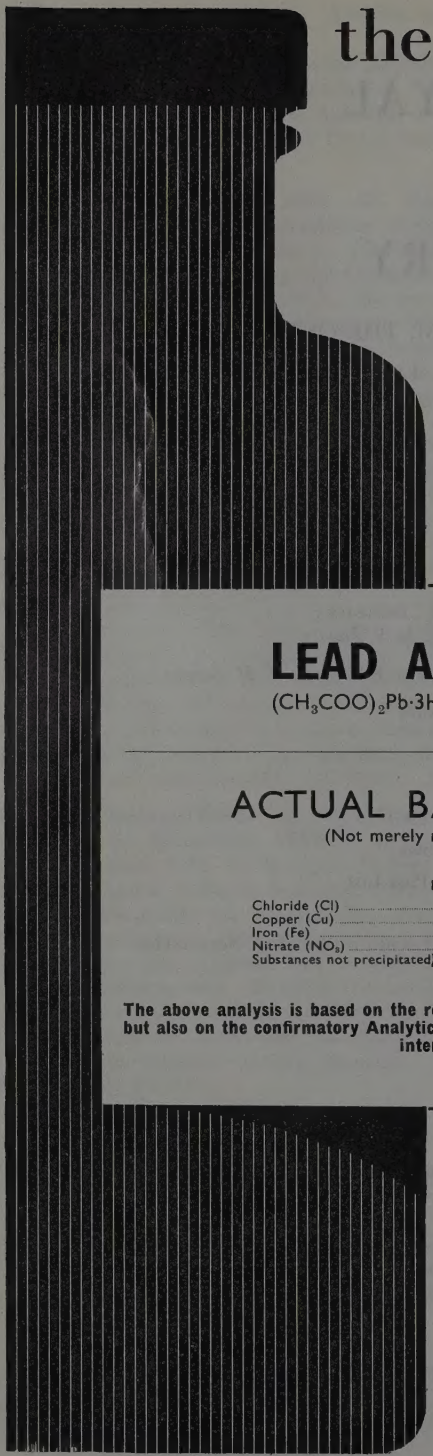

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MASLIN

Biochemical Jubilee.—The Biochemical Society was founded at University College, London, in 1911. To celebrate its 50th anniversary, a meeting has been arranged for 27–29 March, 1961, centred on University College. At a symposium on 'Structure and Synthesis of Macromolecules' to be held on 27–28 March at Senate House, University of London, papers will be read by speakers from England, America and France. The Third Hopkins Memorial Lecture will be given by Sir Hans Krebs at the Royal Institution on the afternoon of 28 March. The morning of 29 March will be devoted to original communications at University College. Non-members of the Society are welcome to attend these scientific functions. The Annual General Meeting and Anniversary Dinner will be held in the afternoon and evening of 29 March at University College.

Society for Visiting Scientists.—The Society, which was founded during the war, offers at 5 Old Burlington Street, London, W.1, a centre at which foreign and oversea scientists visiting the United Kingdom may meet informally with other visitors and with British scientists. Club and restaurant facilities are provided, and there is limited accommodation for overnight stays. There is a small library, and students from overseas studying in England are brought together by the activities of the Overseas Science Students Association, for which the Society provides a home. The work of the Society is made possible by the subscriptions of its British members, a generous grant from the British Council and donations and covenanted subscriptions from industrial and other bodies interested in fostering a closer understanding between scientists of all countries. Further information may be obtained from the Assistant Secretary of the Society.

Staff College for Technical College Teachers.—The names of the first Governors of the proposed Staff College for technical teachers have been announced by the Ministry of Education. They include representatives of industry, local education authorities, universities and technical colleges. The Governing Body will be under the Chairmanship of Sir Alexander Fleck, K.B.E., F.R.S., *Fellow*, who took the lead last February in an appeal to industry to contribute funds towards the initial cost of establishing the college (see *J.*, 115). More than £100,000 has been contributed by 100 industrial firms.

The original suggestion for the establishment of a staff college was contained in a report on 'The Supply and Training of Teachers for Technical Colleges' (the Willis Jackson Report) issued in 1956. This report recommended that there should be a residential college where senior teachers from technical and commercial colleges could associate with industrial management staff and representatives of universities and schools.

Physical Society Exhibition.—The Annual Exhibition of the Institute of Physics and the Physical Society, 1961 (45th Exhibition of Scientific Instruments and Apparatus) will be held at the Royal Horticultural Society's Halls at Westminster, London, S.W.1, and will be open as follows:

Monday, 16 January, 2 p.m.–7 p.m.
(Members and press only, 10.30 a.m.–2 p.m.)
Tuesday, 17 January, 10 a.m.–9 p.m.
Wednesday, 18 January, 10 a.m.–7 p.m.
Thursday, 19 January, 10 a.m.–7 p.m.
Friday, 20 January, 10 a.m.–1 p.m.

Members of the Institute who are not members of the Institute of Physics and the Physical Society but wish to attend the Exhibition on the Members' morning (16 January, 10.30 a.m.–2 p.m.) should send their **request for a special admission ticket** on a postcard addressed to the Editor, Royal Institute of Chemistry, 30 Russell Square, London, W.C.1, as soon as possible. Tickets for the other times may be obtained from 47 Belgrave Square, London, S.W.1.

University Grants Committee Report.—The latest report of the University Grants Committee (*Returns from Universities and University Colleges in receipt of Treasury Grant* 1958–59, Cmnd 1166: H.M.S.O., 4*s.* 6*d.*) states that there were 100,204 university students in 1958–59, of whom 80,805 were reading for a first degree.

In 1958–59, 883 honours degrees in chemistry were awarded (782 men, 101 women), compared with 876 in the previous year, 779 in 1956–57, 752 in 1955–56, 701 in 1954–55, 753 in 1953–54 and 781 in 1952–53. These figures do not include degrees obtained by students in institutions not in receipt of the Treasury recurrent grant.

Civil Service Commissioners' Report.—In the 94th Report, for the year ended 31 March, 1960 (H.M.S.O., 2*s.* 6*d.* net), an account is given of recruitment to the various classes of the Civil Service. The Commissioners have failed to fill an adequate proportion of the notified vacancies in the scientific classes, the deficiences having been most marked in the Scientific Officer grade. The situation in fact worsened during 1959–60, and the present position gives rise to 'grave disquiet.'

Furthermore, the Commissioners have to report that the average quality of applicants in open competition for

the Scientific Officer and Senior Scientific Officer grades has noticeably deteriorated. The shortages are mainly among physicists, engineers, chemists and mathematicians.

PHYSICS IN THE SERVICE OF CHEMISTRY

THE ULTRACENTRIFUGE

By S. DAGLEY, M.A., D.SC., F.R.I.C.
Reader in Biochemistry, University of Leeds

'Without a doubt,' wrote Henry B. Bull[1] in the first article of a famous series devoted to enzymology, 'the most important tool ever devised for the physical study of proteins has been the ultracentrifuge.' At that time, about 20 years ago, it still intrigued the biochemist to reflect that a solution of an isolated protein contained large molecules all of the same weight, differing in this respect from colloidal solutions prepared in the laboratory. The possibility that they were constructed from basic units of molecular weight 17,600 was still a theory to be considered, although no longer generally accepted. During the intervening years there has been a tremendous increase in our knowledge of proteins arising from the application of chromatography, by which some problems of chemical constitution have been solved; and there is great promise that electron-diffraction techniques will reveal details of the shapes of their molecules and enable us to account more fully for their biological activities.

Nevertheless the ultracentrifuge continues to be a tool of first importance. In the years following its invention by Svedberg and his colleagues in 1923 the foundations of protein chemistry were laid; but as Schachman has written, there were throughout the world only eight oil-turbine ultracentrifuges and about the same number of air-driven machines in 1947. There are now more than 300 electrically driven ultracentrifuges. The object of this article is to outline a few of the applications of ultracentrifugation over the last five years and to show that certain notable discoveries would not have been possible without them. Only a very brief reference to the theory of sedimentation and the design of instruments can be made: for a lucid account of elementary principles, the reader is referred to a review by Ogston,[2] while recent developments in theory and techniques are discussed in a splendid monograph by Schachman.[3]

A particle of molecular weight M in solution subjected to a centrifugal field $x\omega^2$ will be acted on by a force $(M/N)x\omega^2(1 - \bar{v}\rho)$ where N is the Avogadro Number, x is the distance of the particle from the axis of rotation, ω is the angular velocity of the rotor, $\bar{v}$ is the partial specific volume of the particles and ρ the density of the solvent. The term $(1 - \bar{v}\rho)$ takes account of the buoyancy of the displaced medium. Thus if the term becomes zero, as may happen when the particle moves through a medium whose density steadily increases with x, the particle will move no further than this point, a fact used in density-gradient analysis. If it is negative, as with lipids and lipoproteins in serum, x will decrease as the particle moves: that is, it floats to the meniscus instead of sedimenting to the bottom of the tube. When the term is positive, the particle will attain a velocity such that the centrifugal force is balanced by frictional resistance to motion: the latter involves forces the same as those which determine rates of diffusion and which depend upon the shape of the particles. Accordingly, when the forces on the moving particle are equated an expression may be derived which is given below, involving the diffusion coefficient, D:

$$M = \frac{RTs}{D(1 - \bar{v}\rho)}$$

Here, R is the gas constant expressed in ergs/degree and s is the sedimentation coefficient, that is, the velocity of the particle per unit field of force. It has the dimensions of time and is usually reported in Svedberg units (S) where $1S = 10^{-13}$ sec. It will be seen that in principle, measurements of velocity will permit molecular weights to be calculated provided that D, $\bar{v}$ and ρ are known. There are, however, several complications in practice (*see* Ogston[2]) such as the dependence of s on concentration; this necessitates several determinations, followed by extrapolation to zero concentration.

The ultracentrifuge may be used in other ways to determine molecular weights. One of these, the sedimentation equilibrium method, employs rotor speeds much lower than those given above so that sedimentation is opposed by diffusion and most of the particles may not deposit at the bottom of the cell. By analogy we may consider the gravitational field of the earth which would sediment the atmosphere down to a dense layer were it not for the opposition of diffusion to this process. The balance of the two factors produces a concentration gradient. Similarly, when the ultracentrifuge is run at relatively low speeds, an equilibrium is eventually established so that the concentration of solute at the bottom of the rotating cell is greater than

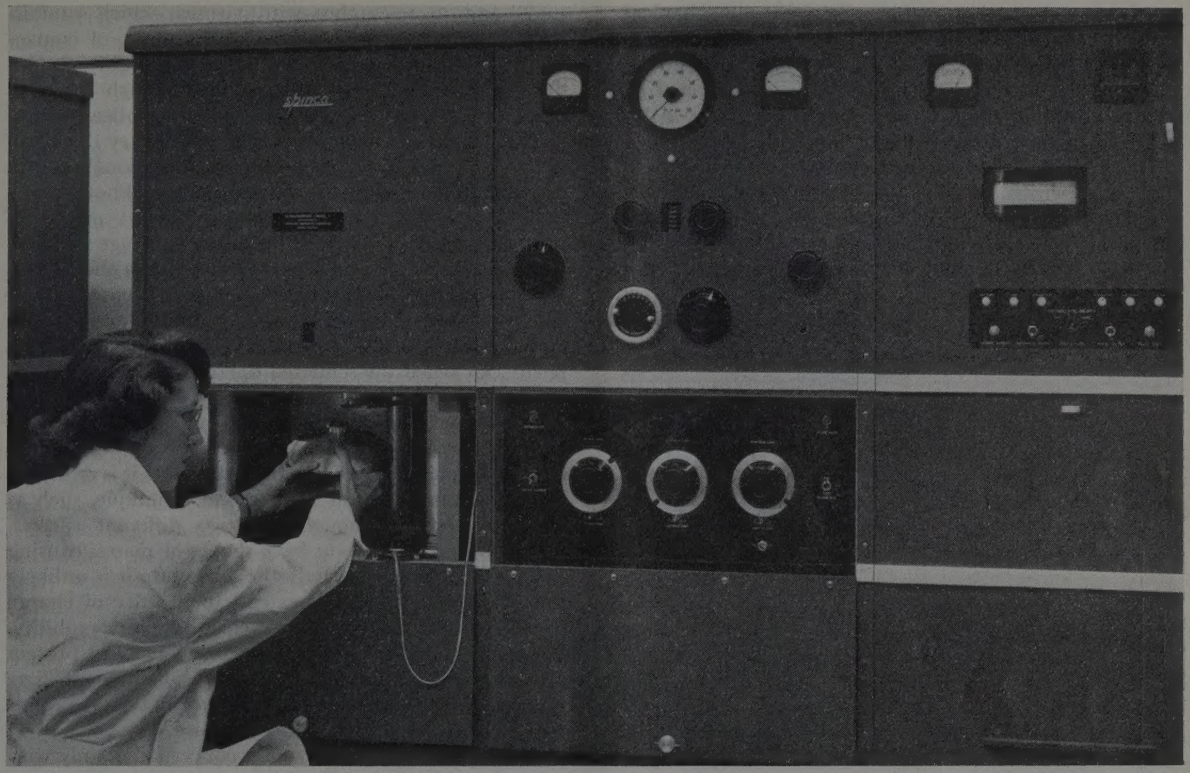

PLATE I. 'Spinco' Model E ultracentrifuge with rotor chamber open. Light from a mercury lamp below the rotor chamber passes up through the rotor cell and is reflected across the top of the machine to a camera or viewing screen at the top right-hand corner. A schlieren optical system is most commonly used

it is near the meniscus. A formula is readily derived to relate concentrations at given distances from the axis of rotation to the molecular weight: it involves $\bar{v}$ and ρ but not D. Thirdly, the method of Archibald (*see* Schachman[3]) is increasingly used. This involves measurements of concentrations at the bottom of the cell or at the mensicus during the *approach* to equilibrium and it does not therefore entail the long periods of waiting before equilibrium is established; this is a disadvantage of the second method discussed, although it may be minimized by reducing the volume of solution in the cell. If c and n are respectively the concentration and concentration gradient at the bottom of the cell (or at the meniscus) and if x is the distance from the axis of rotation, then $\frac{n}{xc} = \frac{\omega^2 s}{D}$, thus furnishing s/D for calculation of the molecular weight.

In their design of instruments capable of developing a centrifugal field sufficient to sediment dissolved molecules, Svedberg and his colleagues[4] displayed an astonishing mastery of both engineering and physical chemistry. Space permits mention only of modern electrically driven ultracentrifuges like that shown in Plate I, capable of attaining 290,000 × g. The rotors shown in Plate II are machined from forged billets of aluminium alloy. In addition to solving engineering

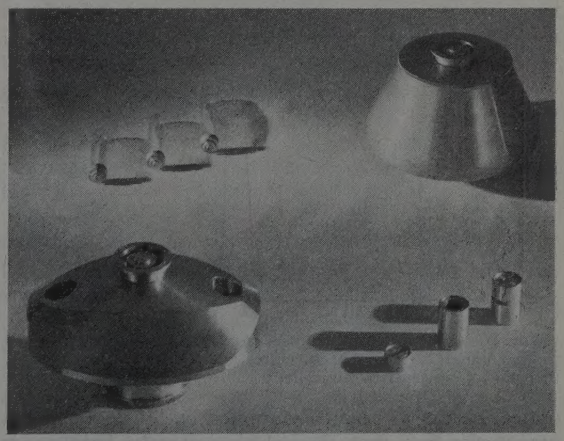

PLATE II. *Top right.* Preparative rotor with (*left*) plastic tubes. *Bottom left.* Analytical rotor with (*from left to right*) a cell centrepiece, cell housing and a counterbalance fitting into the other hole of the rotor

problems such as those arising from great mechanical stress developed at high speeds, it was necessary also to devise methods for following the movement of particles through the medium. Consider particles sedimenting in a cell rotating about O as shown in Fig. 1(i). After a period of time a sharp 'boundary' will be discerned between that part of the cell containing particles and that part which does not. Actually, the boundary 'spreads' a little because of diffusion and on this account the plot of concentration against x, the distance from O, becomes a steep sigmoid curve as shown in (ii). An

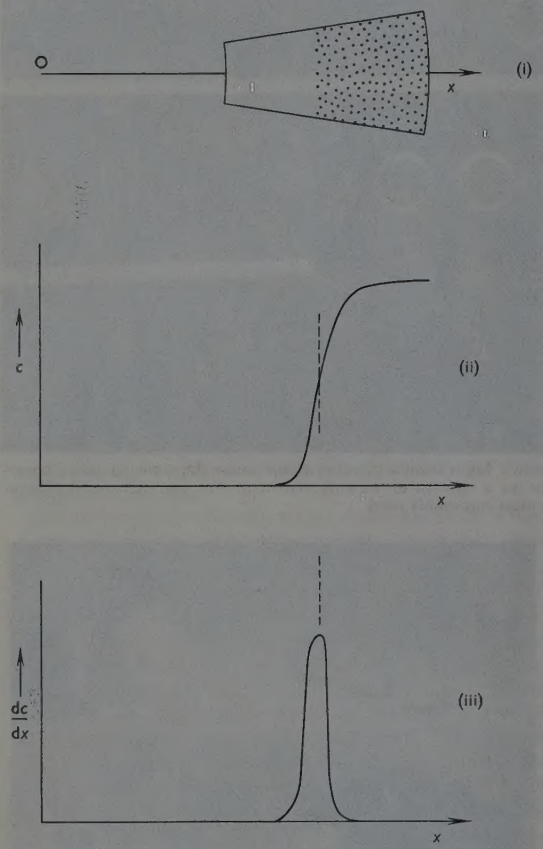

FIG. 1. (i) Sedimenting particles forming a boundary in a cell rotated about O; (ii) plot of concentration against distance from O; (iii) plot of concentration gradient

optical system as originally applied by Svedberg makes use of the fact that the solution absorbs light more strongly than the solvent, so that when a beam of light is passed through the cell and is received at a photographic plate a boundary is shown, whose movement may be plotted from photographs taken at intervals.

Since nucleic acids absorb powerfully in the ultra-violet this method is particularly suited to their study and to researches with viruses, which contain nucleic acids; separate quartz optics must, of course, be used with ultra-violet light. In Fig. 1 (iii), dc/dx, the concentration gradient, is plotted. Such a plot is given directly by the diagonal schlieren optical system of Philpot and Svensson so that the boundary shows up as a peak, the area of which is proportional to the concentration change at the boundary. Photographs of schlieren diagrams are the commonest means of recording sedimentation in the ultracentrifuge: a peak locates a boundary and a peak of large area shows that the component responsible for it is present in high concentration. One of the most valuable applications of the analytical ultracentrifuge is its use to determine purity, for when the schlieren diagram shows one peak, the presence of only one component is suggested. This is not always the case, however; and in order to be certain, the shape of the peak must be shown to be a strictly Gaussian curve. In doubtful cases it is desirable to examine the solution by a second technique, such as electrophoresis. Although the two different species, if they are present, might have shapes or masses causing them to sediment at exactly the same rate it is unlikely that the coincidence will extend to identity of charge density which primarily governs electrophoretic mobility. However, apart from examination of a purified protein after it has been isolated, the analytical ultracentrifuge is invaluable for assessing the efficiency of the operations that constitute a purification procedure.

The type of biochemist who is concerned mainly with enzymic mechanisms—the enzyme mechanic, as we may call him from a distance—believes that there is more to his trade than isolating enzymes and purifying them. A good mechanic not only pulls to pieces but he also reassembles; and although it is a tall order to put back enzymes into the structure from which we ripped them, we do realize that the cell is not merely a bag full of catalysts, even from the chemical viewpoint. The catalysts are organized in a limited space and certain vital chemical activities are characterized by rates higher than those expected from simple diffusion and random substrate–enzyme collision.[5] An absorbing interest of modern biochemistry is therefore to find out which structures in the cell carry particular enzymess and in this connexion, methods using the ultracentrifuge have made notable contributions. The mitochondria are one such type of structure. They are found in almost all plant and animal cells and measure, in diameter, 0·2–0·5 μ, and in length, 0·3–5·0 μ. Cells can be broken down by methods which do not disrupt the mitochondria and these can then be isolated from other structures by centrifuging at various speeds and for various times. Mitochondria have been called the 'power houses' of the cell because they possess an assemblage of enzymes by which they can oxidize to completion fatty acids and intermediates of the Krebs cycle; the cytochrome oxidase of the cell is almost

exclusively located inside them; and they are able to harness the energy released during these oxidations by phosphorylating adenine nucleotides. In recent years de Duve[6] and his colleagues have shown that when isolated by the usual procedures, mitochondria are mixed up with a new group of cytoplasmic particles called lysosomes. When they are freshly isolated, lysosomes appear to be little bags full of hydrolases like ribonucleases, phosphatases and cathepsins, that is, enzymes that cause dying cells to autolyse. In living cells the skins of these bags are intact; when liver is damaged or deprived of blood the enzymes are released, an event which also follows exposure of lysosomes to enzymes that attack lipids or proteins, presumably because the bags are thereby punctured. The crucial experiments of this fascinating work made use of density gradient centrifuging, which showed that the enzymes of the mitochondria sedimented together, that is, they were all attached to the same structure; whilst the hydrolases of what are now recognized as the lysosomes were grouped in a different pattern.

Gradient centrifugation may be of two kinds. A fairly small concentration gradient may first be established in the tube by use of a sucrose solution rather more dense at the bottom of the tube than at the top. Various devices have been constructed for introducing solutions into preparative centrifuge tubes in this way.[7,8] The purpose of such a gradient is to reduce convection so that the contents of the tube do not get mixed up. The second method (isopycnic gradient centrifugation) uses a much steeper gradient and its purpose is to allow particles to sediment until they reach a point of equal density when, as discussed above, they will remain stationary. For this type of work the preparative rotor may be fitted with devices to prevent the tube contents from being stirred up during acceleration or slowing down (*see* de Duve *et al.*[7]) and an ingenious 'tube sectioner' has been made to cut across a plastic tube full of liquid without spilling any, so that slices of solution at given distances from the axis of rotation may be removed and analysed. The preparative rotor shown in Fig. 1 is not used in these experiments since its tubes are rotated at a fixed angle to the vertical. Under such conditions some particles hit the side of the tube and slide down to the bottom more quickly than they would normally — a process which sets up convection currents and makes it impossible to obtain quantitative data. Workers such as de Duve use a preparative rotor in which the tubes swing out into a horizontal position when rotated. Since the tubes have parallel sides and are not sector-shaped like an analytical cell (*see* Fig. 1) sedimentation is not ideal: that is, some collisions with the tube walls by particles moving radially are to be expected; but sedimentation is much more predictable in 'swinging buckets,' as they are called, than in the tubes rotating at a fixed angle to the horizontal. However, for non-quantitative preparative purposes the fixed-angle centrifuge is not only satisfactory but has advantages over the swinging bucket.

Lindgren, Elliott and Gofman[9] isolated the lipids from other constituents of human serum by first adjusting the serum to a density of 1·063 by addition of NaCl and then centrifuging, when lipids and lipoproteins floated. Next, the components of the mixture were separated by adding NaCl to a solution of the lipids to bring to a given density; this solution was then placed below a layer of pure salt solution of slightly lower density. During centrifugation the lighter lipids entered the upper layer of brine: the lightest entered most quickly, and when the time of centrifuging was suitably chosen, a fractionation could be achieved. The fractions were characterized by determining their flotation coefficients, expressed in Svedberg units. The sera of over 6,000 individuals were studied and the authors showed an association of atherosclerosis with the amounts of 10–20 S_f components present. Other authors have questioned the validity of using these components for diagnosis of coronary sclerosis on the grounds that they are present in the serum of normal persons and are not always increased in coronary disease.

The ultracentrifuge has been used for investigations in very different fields of research. Thus, the existence had long been suspected of colloidal particles in petroleum which, if present, might be expected to have effects on the chemical and physical properties of the oil; but up to 1957 there was no unequivocal evidence to prove their existence despite extensive work involving osmosis, diffusion, electrophoresis and ultra-filtration. Ray, Witherspoon and Grim[10] centrifuged crude Illinois petroleum at 80,000 × *g* for periods up to 12 days and obtained four fractions: a black organic sediment, and in the liquid above it, two zones containing red and black colloidal particles; the top layer of oil was a yellow-green translucent fluid of decreased viscosity and density. The sediments were investigated in the analytical rotor and shown to consist of particles with an average molecular weight of about 30,000 containing a relatively high proportion of nickel and vanadium.

It would be a lifeless teacher of biochemistry who failed to revise 30 per cent of his lecture notes every two years; but fortunately there is no such person: the very vigour of the subject with which he must try to cope prevents stagnation. What biochemist is there who does not open each new issue of *J. biol. Chem.* with anticipation tinged with apprehension: a state of mind brought on more frequently since *Biochim. biophys. Acta* adopted a bimonthly publication policy? Modern biochemistry deals with tremendous themes, and current publications may affect the very foundations of the subject. Thus, at intervals during the last ten years the citrate-forming condensing enzyme was crystallized, the structure of insulin determined, the fatty-acid spiral and the porphyrin-synthesizing cycle elucidated, the pathway of carbon in photosynthesis traced and the

significance of mevalonic and shikimic acids discovered. The nature of the process by which proteins are synthesized in the living cell would seem to be the great problem of the 1960s; and towards its understanding, studies with the ultracentrifuge have already made contributions of first importance. The crux of the problem is to find out how the different amino acids of a protein molecule come to be joined together in a unique sequence which appears to confer that remarkable biological specificity so characteristic of enzymes and other proteins. Current speculations favour template mechanisms: that is, it is thought that there exist at all times in living cells giant molecules (believed to be ribonucleic acid, RNA) along the length of which are regions to which particular amino acids are brought before they are joined together by peptide linkages. The region of the molecule that accommodates glycine does not suit glutamic acid, and that which suits glutamic acid does not fit lysine, and so on. To explain why one region of an RNA molecule should match one amino acid but not another, it is suggested that each amino acid is united with its own particular small ('soluble') RNA molecule and it is this which fits on to the giant RNA since it has a base sequence exactly corresponding (complementary) to that region; and so the 'soluble RNA' takes the amino acid just where it has to go. Studies with the ultracentrifuge have established that two such types of RNA differing greatly in size are to be found in cells. Ultimately the genes determine what type of protein molecule, and therefore what RNA templates, will be made; and it is proposed that genes are in fact chemical compounds, namely desoxyribonucleic acids (DNA) which contain the codes in the form of particular sequences of bases in their molecules, these sequences being passed on to RNA during synthesis of the latter. Thus, 'DNA makes RNA, and RNA makes protein.' The model for the structure of DNA proposed by Watson and Crick has provided a great stimulus for thought and research about biological replication in general and protein synthesis in particular.

Details of the now famous Watson–Crick structure and mechanism of replication[12] will not be given here, since it is only intended to show the part played by studies with the ultracentrifuge to test one aspect of the theory. Essentially, the DNA molecule is thought to consist of two strands which are so joined together that the sugar-phosphate backbone of one strand is held at a constant distance from the other along its whole length. This is achieved as shown in Fig. 2 by pairing off a purine with a pyrimidine, the dimensions of each base being such that adenine, say, must always pair with thymine and guanine with cytosine. The bases stick together by hydrogen bonding. When the cell divides and the two strands separate, new double molecules will be made by new strands forming on the top of those already in existence. The new strand that forms on top of (*a*), Fig. 2, will have the same base sequence as (*b*); and this sequence, in a long molecule—only a small part of which is shown in the figure—will be one particular arrangement out of millions of possibilities. Similarly if an RNA strand is formed on (*a*) it will also have this unique sequence and may form the template for a protein with a unique array of amino acids. The crucial features of this account are: first, that DNA is double-stranded; and second, that when the cell divides, DNA molecules split lengthways. These assumptions have been tested by Meselson and Stahl[13] as follows.

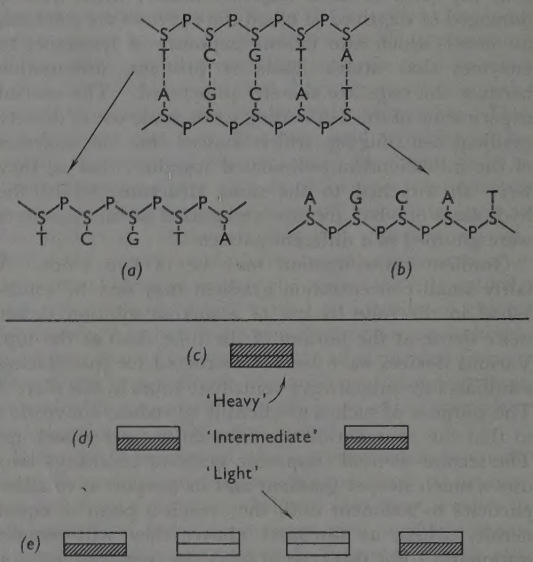

FIG. 2. *Above.* Base pairing in DNA, after Watson and Crick.[12] A double strand molecule is shown to give rise to two single strands (*a*) and (*b*). A,G: purine bases, adenine and guanine. C,T: pyrimidine bases, cytidine and thymine. The dotted lines represent H– bonding. S: sugar (deoxyribofuranose) residues. P: phosphate (diester) groups

Below. The figure illustrates the experiment of Meselson and Stahl[13] (*see* text), showing how DNAs of different densities arise

Bacteria were grown in a medium supplying ^{15}N as sole source of nitrogen so that all their DNA contained heavy nitrogen (*see* Fig. 2*c*). A great excess of ^{14}N was then added and the bacteria grew: one would now expect the 'heavy' DNA to divide and new 'light' strands to be synthesized so that after one generation an 'intermediate' DNA would be given (*see* Fig. 2*d*). After two generations, both intermediate and light DNA would occur as in (*e*), and so on. Meselson and Stahl extracted DNA from the bacteria after one, two, three and four generations and showed that the weight of the DNA molecules and their distribution was exactly as predicted by the theory. To do this they used a density gradient method: not, in fact, of the type already discussed in which the gradient is made before centrifuging begins, but rather by use of a dense solute, caesium

chloride. Molecules of this salt are large enough to be concentrated at the bottom of the ultracentrifuge cell at high gravitational fields in opposition to diffusion, and so a density gradient is set up during the run. The method was sensitive enough to show that bands of heavy, light or intermediate DNA would form at different points along the cell according to their respective densities.

The RNA of cells consists of the relatively low molecular weight ('soluble') RNA already discussed and 'microsomal RNA': this is not free RNA but is bound to protein. When disrupted mammalian cells are centrifuged, a light 'microsomal fraction' can be separated from the heavier mitochondria. Electron microscopy shows that these microsomes consist of pieces of very thin membrane with little particles of ribonucleoprotein (RNP) attached. The particles have been called 'ribosomes': they are 100–150 Å in diameter; and they can be obtained free from membranous material by treatment with deoxycholate and other detergents. In bacteria the electron microscope shows the ribosomes scattered at random throughout the cytoplasm; disintegrated bacteria are therefore a good source of ribosomes because they do not need to be detached from membranes before isolation. In fact, when the cell walls of bacteria are broken and the contents are dissolved in phosphate buffer to give a so-called 'cell-free extract,' the main peaks in schlieren diagrams photographed in the ultracentrifuge are due to ribosomes. Plate III*a* shows such a photograph and the boundaries which are marked as sedimenting at 40*S*, 25*S* and 18*S* are all due to RNP ribosomes: the broad band at 8*S* is due to a complex mixture of other types of macromolecules. When the ribosomes are isolated by differential centrifugation and then re-sedimented in a medium of lower viscosity than a crude bacterial extract, the coefficients of the two faster-moving particles are nearer to 50*S* and 30*S* and their molecular weights are then calculated to be 1·8 and 0·75 millions respectively. In the presence of Mg^{2+} ions one molecule of each of these ribosomes combines[14] to give a particle of M.W. 2·6 millions sedimenting at 70*S*; and in turn, two 70*S* particles can combine, when the Mg^{2+} ion concentration is further increased, to give a particle with a sedimentation coefficient of 100*S*.

The larger ribosomes from bacteria (70*S* and 100*S*) have aroused great interest because they are about the same size as ribosomes from plants and animals. In these days when the number of fundamental particles in physics appears to increase monthly it affords many people satisfaction to discern a standard size of ribosome, a new fundamental particle, in biochemistry. But in the brief history of the ultracentrifuge we have already seen the birth and death of the concept of a basic unit of 17,600 in protein structure and we ought to pause before we use Occam's Razor to cut out the smaller bacterial ribosomes which seem to blemish the fundamental biochemical unities. The question is not whether the large ribosomes can exist and function in bacteria: one believes they can and do; but are they essential for metabolism? When isolated, they are very sensitive to changes in salt concentrations, so that if a medium contains more than a critical amount of inorganic phosphate or less than a critical amount of

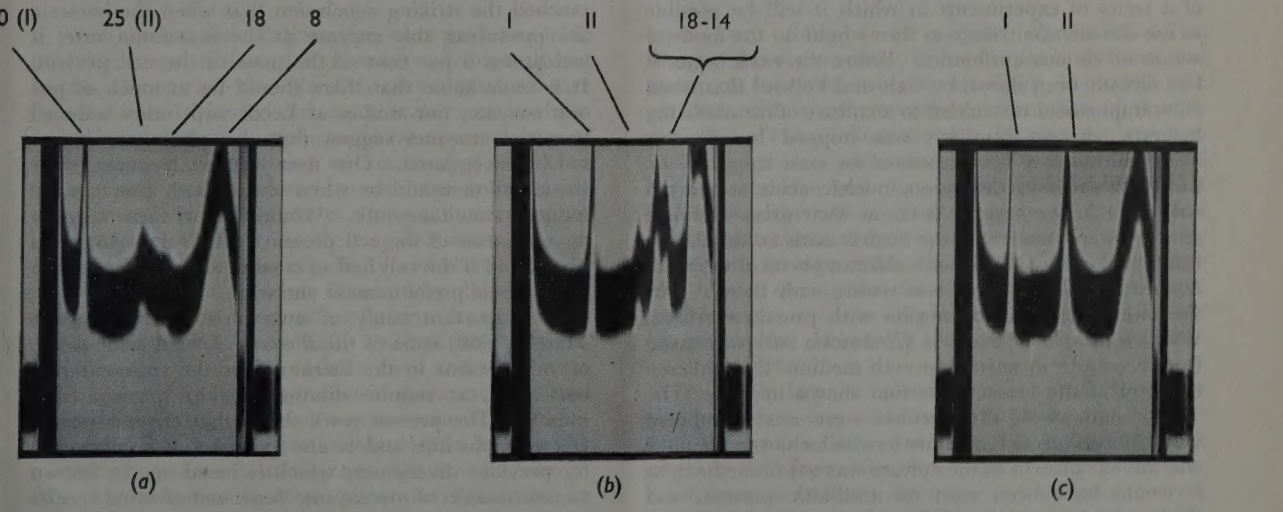

PLATE III. Schlieren diagrams for cell-free extracts of *Esch. coli*. Sedimentation (187,000 × *g*) is to the left. The numbers 40, 25 *etc.* are uncorrected sedimentation coefficients in Svedberg units; components I and II, if isolated from the extract, would sediment at about 50*S* and 30*S* respectively in a medium of lower viscosity. (*a*) diagram for cells grown normally; (*b*) for cells incubated with chloramphenicol; (*c*) for cells which gave (*b*) and were then grown for 30 min in absence of antibiotic

Mg^{2+} ions they are broken down to 30*S* or 50*S* ribosomes. This behaviour contrasts sharply with the relative indifference of the bacteria themselves to changes in the salt concentrations of their growth media. Admittedly, the cells may operate mechanisms for regulating salt concentrations but we know little about them and we cannot say whether the amounts of particular ions are so controlled as to preserve the big ribosomes intact under all conditions of culture. Further, when the shapes of 70*S* and 100*S* particles are outlined by the electron microscope they appear to consist of smaller ribosomes joined together so that the shapes of the latter can still be seen. It is difficult to visualize what it is, at the molecular level, that ribosomes of *M* 1–2 millions can do when stuck together that they cannot do when apart. Finally, current theory suggests that microsomal RNA is template RNA. However, a number of observations suggest that the RNA in ribosomes is tightly rolled up in a ball with protein on the outside. How can such RNA act as a template when it does not appear to be accessible? The answer may be that when the RNP has been isolated it is not in the physical form it had inside the cell; there, the ribosomes may be 'unwrapped' and the RNA exposed, and during isolation the particles may roll up into balls. If this were so, there would be even less point in postulating that a ribosome must be at least a certain minimum size before it can function in metabolism.

During the last year or two, my colleague Dr Sykes[15,16] has shown that the antibiotic chloramphenicol (chloromycetin) produces marked changes in the pattern of soluble macromolecules extractable from disrupted bacteria. I believe that this is the forerunner of a series of experiments in which it will be possible to use the ultracentrifuge to throw light on the mode of action of various antibiotics. Before the work began it had already been shown by Gale and Folkes[17] that when chloramphenicol was added to a culture of metabolizing bacteria, protein synthesis was stopped but nucleic acids continued to be synthesized for some time. Now, from our previous discussion, nucleic acids are linked with protein synthesis. As far as their gross chemical analyses were concerned, the nucleic acids accumulating inside bacteria poisoned with chloramphenicol were not abnormal. What, then, was wrong with them? For they were useless in connexion with protein synthesis. When a sample of bacteria (*Escherichia coli*) was taken from a culture in normal growth medium the schlieren diagram of the extract was that shown in Plate III*a*. The remainder of the bacteria were next incubated with the same growth medium to which chloramphenicol was added: growth of the culture was not immediate, as it would have been with no antibiotic present, and during this lag period schlieren photographs for extracts of the drug-treated cells revealed a build-up of new components sedimenting at 14–18*S* (*see* Plate III*b*). This proved to be a different type of RNP from that normally found in ribosomes: for one thing, it was readily broken down to small particles of RNP by sonic vibrations whereas 30*S* and 50*S* ribosomes are not; and one imagines that this new material is useless for protein synthesis. Of course, chloramphenicol may have additional effects that are important in this connexion: the wrong type of 'soluble RNA' may also be formed and this would not show up in ultracentrifuge studies. When the cells recovered from treatment with the antibiotic and began to grow again, the abnormal RNP was rapidly broken down and there was a striking increase in the amount of normal 30*S* ribosomes in the cytoplasm (Plate III*c*).

The use of the ultracentrifuge in fundamental research is now a commonplace, as a glance through current journals will show. Thus, there are two good examples in the March (1960) issue of *Biochem. et biophys. Acta*. The chemistry of the enzymic oxidation of α-oxoglutaric acid to succinyl-CoA is complicated; three main steps are recognized: the first is a decarboxylation, the second gives succinyl-CoA along with reduced lipoic acid and the third regenerates oxidized lipoic acid to take part again in the first step. By various methods, including use of the analytical ultracentrifuge, Massey[18] showed that these reactions occur on a protein complex of $M = 260{,}000$, which is made up of a colourless part on which the first two reactions are catalysed and a yellow flavoprotein part catalysing the third. In the cell, it seems that eight of these complexes are joined together in a giant polymer of $M = 2$ millions. In another paper, Garen and Levinthal[19] used the ultracentrifuge to check their purification of a phosphatase that *Escherichia coli* can be induced to develop and they reached the striking conclusion that when the bacteria are producing this enzyme at the maximum rate, it constitutes 6 per cent of the mass of the cell protein. It is remarkable that there should be so much of just one enzyme, but studies at Leeds with other induced bacterial enzymes suggest that this phosphatase may not be exceptional. One does wonder, however, what the situation would be when several such enzymes are induced simultaneously. Would four of them account for a quarter of the cell protein? This does not seem likely, and if the cell had to choose, one wonders which one it would prefer to make and why.

An important study of myosin is reported in the March (1960) issue of the *Biochem. J.*[20] A wide range of values exists in the literature for the sedimentation coefficient, at infinite dilution, of this protein from muscle. The present work shows that the value is in fact reproducible and it also provides an explanation for previous divergences which is based on the known transformation of myosin into faster-sedimenting species when the temperature is raised. If, at temperatures above 23°, the protein is sedimented at high centrifugal fields the fast component separates continually from the main boundary and travels ahead of it—not to produce

a new boundary in schlieren diagrams but merely to raise the base line slightly in front of the main peak. As a result, the protein concentration at this boundary progressively falls during centrifuging and the boundary moves faster since the rate of sedimentation of myosin rises as concentration falls. At low centrifugal fields these effects are not observed because interdiffusion of myosin and its transformed component maintains a constant concentration. Several experiments were performed to support this interpretation, which provides an explanation of anomalies without evoking any unusual hydrodynamic properties for the myosin molecule. This is one of several very instructive investigations by Johnson and his co-workers in which at various times the ultracentrifuge has been used to study the transformation or dissociation of proteins.

This article began with a generalization made 20 years ago, and a good case for it can still be made out. In fact, nowadays one might not wish to restrict the argument to the physical study of proteins.

I wish to thank Beckman Instruments, Inc., for the photographs in Plates I and II, Mr T. J. Bowen for reading and correcting the manuscript and the Medical Research Council, whose support made possible our studies in Leeds.

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REACTIVE DYES AND CELLULOSE FIBRES

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When the first three Procion dyes were made available in 1956 it was evident that a new era in dyeing had begun. Since that time the Procion range of reactive dyes has been expanded very considerably and has been joined in markets all over the world by representatives of other reactive dye systems. Reactive dyes as a class are now well established and because of their increasing importance it is worthwhile to attempt to uncover the basic principles underlying their application.

The classical concepts of affinity and diffusion must play an important role but, in addition, the reactivity of the dye must be a controlling factor. In all reactive dye systems dyeing is essentially a competition between two reactions—of the dye with the fibre and with water. Since water is frequently present in great excess it is at first sight surprising that such a system can be successful. It is the object of current work not only to indicate the relative importance of affinity and diffusion but also to show why it is that reactive systems for dyeing are in fact possible.

The rates of reaction of cold-dyeing Procion dyes (dichloro-s-triazine derivatives) with water and the carbohydrate mannitol (as a simple 'model' for cellulose) have been followed at various alkalinities. This showed that the reactivity of the dye for both water and mannitol increased as the alkalinity increased, the reaction with water increasing more than that with mannitol. This indication of a bimolecular reaction was verified by postulating that reaction occurred between the dye and the ionized species in solution, that is, the hydroxyl ion and the mannitol ion. When the concentrations of the respective ionized species were taken into account it was found that the ratio of the reactivity of dye for the mannitol ion and for the water ion became constant at all pH values. For the particular dye studied the ratio of the reactivities of mannitol : water was 14 : 1.

The difficulties in extending this approach to the problem of dyeing cellulose result from two factors. First there has hitherto been no clear indication as to whether cellulose ions exist under Procion-dyeing conditions; in addition there are obvious complications of transference to and diffusion through the solid

* Abstract of a lecture given to the Huddersfield College of Technology Chemical Society and the Huddersfield Section of the Royal Institute of Chemistry on 18 November, 1959.

phase, which is absent in the simple mannitol/water system. These will be dealt with in turn. By postulating the absorption of sodium hydroxide by cellulose as a process of neutralization of a base by a weak acid (that is, by postulating the formation of cellulose ions) we can set up theoretical equations embodying the well-accepted concepts of dyeing thermodynamics. From these it is possible to predict the amount of sodium hydroxide which will be taken up at equilibrium from baths containing various concentrations of sodium hydroxide. The calculated results are in close agreement with the practical measurements. In addition, the theory has been shown, for the first time, to compensate for the fall in substantivity of a dye as the alkalinity increases—a point clearly demonstrated by the fact that a constant affinity can now be calculated for dyeing carried out from dyebaths at various pH values.

The problem of rate of fixation on cellulose has been simplified by using viscose sheet rather than fibre. Rate of fixation, affinity and rate of diffusion have been measured over a wide range of pH values, and an equation due to Danckwerts has been applied to the results. This equation has the form

$$Q = c\sqrt{Dk}(t + 1/2k)$$

where Q = amount of dye diffusing through unit area of surface, which in this case is equated with the amount of dye fixed; c = equilibrium surface concentration which can be calculated from the thermodynamic affinity; D = diffusion coefficient; k = reaction constant of dye with cellulose; t = duration of the experiment.

All the quantities are known except k, which can now be calculated and compared with the reaction constant for water.

When this is done it is again found, as for mannitol, that as the pH rises the reactivity of the dye with water increases more rapidly than the reactivity with cellulose. However, when the degrees of ionization of cellulose and of water are inserted, the ratio again becomes constant over the whole pH range. For the dye investigated, the ratio k (cellulose)/k (water) turned out to be unity.

Thus a surprisingly simple picture of the reaction of Procion dyes (and presumably other reactive systems) with cellulose emerges. The reaction takes place between the dye and the cellulose ions produced by neutralization of cellulose by alkali; the reactivity of cellulose ions appears to be similar to the reactivity of the water ions, although so far no allowance has been made for possible steric effects in the solid cellulose phase. The reason why Procion dyes react to a greater extent with fibre than with water is due largely to the greater number of cellulose ions than hydroxyl ions present in the bath. In addition, affinity and diffusion play an important part by producing preferential adsorption of dye on the fibre.

BIOLOGICAL MACRO-MOLECULES

A Symposium on 'Naturally-occurring Macro-Molecules of Biological Importance' was held at Birkenhead Technical College on Saturday, 26 March. About 150 people were present. Professor G. W. Kenner, of Liverpool, took the chair in the morning session, which was opened by Dr D. C. Phillips, of the Davy-Faraday Research Laboratory, Royal Institution, who spoke on 'X-ray Diffraction Studies of the Proteins Haemoglobin and Myoglobin.'

X-ray diffraction analysis of crystal structures can be regarded as an extension of microscopy in which X-rays are used in place of light in order to increase the resolution. Since lenses are not available to focus the X-rays, it is necessary to measure the X-rays reflected by the crystal and to form the image from them by calculation. Unfortunately some information, the relative phases of the X-rays reflected in different directions, is lost and additional measurements have to be made from related crystals in order to recover this information, which is needed for calculation of the image. The resolution of the X-ray 'microscope' depends on its aperture, that is effectively on the number of reflections used in forming the image.

X-ray analysis of protein structures has been in progress since 1937 when M. F. Perutz began his work on haemoglobin. It first seemed likely to succeed in 1954 when Perutz used the method of recovering the lost phase information from measurements of related crystals. Crystals have to be used which differ from crystals of the pure protein only in that one or two heavy atoms, usually mercury, are attached specifically to each protein molecule. Several different heavy-atom derivatives of this kind are needed.

This method has been applied successfully to the study of haemoglobin, and the related protein myoglobin, by Perutz and Kendrew and their colleagues. A low-resolution image of myoglobin was first obtained, by the measurement of about 400 reflections from the protein crystals and from each of five different heavy-atom derivatives. In this image the so-called tertiary structure, the general arrangement of the coiled polypeptide chain, can be seen though not the way in which the chain is coiled (the secondary structure). In addition the position of the haem group is revealed.

Recently a similar low-resolution image of haemoglobin has been obtained by the measurement of about 1,000 reflections from each of seven crystal types. This image shows that the haemoglobin molecule is made up of four sub-units, in two pairs, each of which is very similar indeed to a single molecule of myoglobin. These four units are in a roughly tetrahedral arrangement and make up a spheroidal molecule about

64 × 55 × 50 Å in size with the four haem groups lying in pockets on the surface. Some additional features can be deduced from the close relationship with myoglobin, which has now been examined in greater detail.

The latest image of myoglobin has been calculated from about 10,000 reflections from each of five different crystal types. Resolution of 2 Å has been achieved, so that individual atoms, which are generally about 1·5 Å apart, still cannot be seen but many atomic groupings can be recognized. In particular it can be seen that about 70 per cent of the polypeptide chain is present as right-handed α-helix (Pauling and Corey), and the carboxyl and amino ends of it can be distinguished. It can also be seen that the haem group is attached to the polypeptide chain mainly by a bond between the iron atom and a side chain which is most probably histidine. About 35 of the 153 residues have been identified, and it is expected that many more will be identified as analysis of the image proceeds.

The second speaker was Dr S. G. Smith, of the Shirley Institute, Manchester, who spoke on 'The Molecular Structure of the Silk Fibroin of *Bombyx mori*.'

Of the vast range of filaments produced by various insects and spiders, that of the larva or 'silk worm' of *Bombyx mori* is the best known. In order to make use of specific fission of the molecular chains of fibroin by enzymes, the fibroin must first be got into solution. An aqueous solution can be obtained by dissolving the protein in a suitable solvent (*e.g.* cupriethylenediamine or lithium thiocyanate) and dialysing in a cellophane sac against distilled water.

When such a solution of fibroin is acted upon by chymotrypsin, a precipitate is formed from the specific action of the enzyme on the α-carboxyl groups of the tyrosine residues. This precipitate contains approximately 60 per cent of the total nitrogen of the protein and consists almost entirely of glycine, alanine and serine, together with a little tyrosine, the molar ratios of glycine to alanine to serine being 3 to 2 to 1. The fraction has a high degree of crystalline order as shown by X-rays, and a molecular weight of about 4,000.

The detailed analysis of this chymotryptic precipitate shows that its formula is $Gly_{29}Ala_{20}Ser_9Tyr$ and the *C*-terminal position has been shown to be occupied mainly by tyrosine together with a little phenylalanine.

The sequence of the amino acids in the chymotryptic precipitate has been determined. The elucidation of this sequence was greatly facilitated by the absence from hydrolysates of the chymotryptic precipitate of Gly.Gly, which could not be detected even after careful search in a number of experiments. The absence of Gly–Gly bonds, and the analytical values showing that one-half of the total residues are glycyl, means that every alternate residue must be derived from glycine. If seryl residues are evenly spaced within the molecule, they will occupy every sixth position, and a repeating hexapeptide sequence, Ser.Gly.Ala.Gly.Ala.Gly, would be a dominant feature of the molecule.

By using the *N*-acyl to *O*-acyl transformation that occurs at the seryl residues when proteins are dissolved in anhydrous mineral acids, followed by specific fission at these residues, 36 per cent by weight of the chymotryptic precipitate has been isolated as this hexapeptide in the form of its dinitrophenyl derivative. The yield would undoubtedly be considerably greater, but for the difficulty of preventing unwanted fission and re-combination during the treatment.

The products of the partial hydrolysis of the chymotryptic precipitate by concentrated HCl have also been examined, the dinitrophenylated mixtures being separated by column chromatography into their constituents, which were estimated quantitatively, a maximum recovery of 87 per cent, on a nitrogen basis, being obtained.

The *N*-terminal amino acid residues of the chymotryptic precipitate were determined by treating it with 1,fluoro-2,4-dinitrobenzene, hydrolysing, and separating and estimating the dinitrophenylamino acids. Glycine occupied 84 per cent of the *N*-terminal amino positions, serine 10 per cent and alanine 4 per cent.

Consideration of all the evidence leads to the conclusion that the chymotryptic precipitate is composed mainly of a repeating sequence—Ser.Gly.(Ala.Gly)*n*—where *n* is usually 2, and must have, by requirement of the analytical data, an average value of 2. In addition to this principal constituent, a small amount of Ala.Ala is present, together with a *C*-terminal tyrosine residue and an *N*-terminal sequence in which mainly glycine provides the *N*-terminal amino residue.

The chymotryptic precipitate is thus composed of an aggregation of sections of the fibroin molecule, these sections having the formula

$$Gly.Ala.Gly.Ala.Gly[Ser.Gly.(Ala.Gly)_n]_8Ser.Gly.Ala.Ala.Gly.Tyr$$

where *n* is usually 2, and always has a mean value of 2.

The fraction of fibroin that remains in solution following the removal of the chymotryptic precipitate contains all the amino acids with large side-chains that occur in fibroin, apart from the small amount of tyrosine remaining at the *C*-terminal position of the chymotryptic precipitate. In addition it contains substantial amounts of glycine, alanine and serine.

The chymotryptic liquor consists of a solution of peptides each ending in the *C*-terminal position with tyrosine, phenylalanine or possibly tryptophan. The mean chain-length of the mixture is approximately 8. Separation of these peptides on a resin column yielded 25 fractions, of which two fractions accounted for 52 per cent of the total molar yield of peptides. Examination of these two fractions showed that they contained the following amino acid sequences:

Gly.Ala.Gly.Ala.Gly.Ala.Gly.Tyr
Gly.Ala.Gly.Val.Gly.Ala.Gly.Tyr
and Gly.Ala.Gly.Tyr.

Work is continuing on the identification of the remaining peptides.

There was a lively discussion after this lecture, and the vote of thanks was proposed by Dr H. Heaney.

The Chairman in the afternoon session was Lord Cohen of Birkenhead, who introduced the first speaker, Dr F. Sanger, F.R.S., of Cambridge, Nobel Prize Winner 1958, who spoke on 'Amino-acid Sequences in Proteins', with particular reference to insulin, ribonuclease and haemoglobin.

Structure of insulin.—End-group determinations by the DNP method showed the presence of one glycyl and one phenylalanyl *N*-terminal residue. Oxidation split the insulin into its two polypeptide chains. By partial acid hydrolysis and fractionation of the resulting small peptides by paper chromatography short sequences in both chains were determined. The complete sequences were deduced by studying the large peptides given on enzymic hydrolysis. The distribution of the disulphide bridges was determined by studying the cystine peptides resulting from hydrolysis of unoxidized insulin.

Structure of ribonuclease (Hirs, Moore and Stein).—Enzymic hydrolysates of oxidized ribonuclease were fractionated on ion-exchange columns and the resulting peptides subjected to accurate amino-acid analysis. From these results a partial structure of ribonuclease was determined. Further detailed degradative studies on the isolated peptides were required to deduce the complete sequence.

Other recent studies.—Ingram used two-dimensional paper fractionations (finger-prints) to detect the chemical difference between normal and 'sickle-cell anaemia' haemoglobin and showed that they differ in only one amino-acid residue. Tuppy studied the structure of haem-containing peptides in hydrolysates of cytochrome *c* from different species. Isotopic methods have been used to study the structure around the active centres of certain DFP-sensitive enzymes, and the further application of isotopic techniques was discussed.

The fourth lecture was by Dr J. Rudinger of the Czechoslovak Academy of Sciences, Prague, who discussed methods of synthesis of peptides. Peptide synthesis involves the linking together of amino acids or their derivatives in the correct sequence. This requires that the free amino and carboxyl groups which are not to react must be protected, and then that the free carboxyl and amino groups should be made to condense together.

Various protecting groups for the amino group were discussed in turn, such as benzyl oxycarbonyl ($C_6H_5CH_2O{\cdot}CO$–), first introduced by Bergmann, tosyl (*p*-toluene sulphonyl, $CH_3C_6H_4SO_2$–) and triphenylmethyl (trityl). These were critically examined with regard to their subsequent ease of removal.

The carboxyl group is protected by esterification with simple alcohols or *p*-nitrophenol.

Coupling of the suitably protected amino acids can be achieved by the use of cyanomethyl esters, carbodiimides or tetraethylpyrophosphite.

The lecturer then illustrated the use of the above methods by reference to syntheses of oxytocin and vasopressin, peptide hormones of the posterior pituitary, carried out by himself, and other workers. The synthesis of amino-acid polymers and copolymers and the contribution made by this work towards an understanding of the properties of proteins was reviewed and further synthetic approaches to this problem discussed.

The discussion was opened by Professor M. Goodman of the Brooklyn Polytechnic, New York, who referred briefly to his own work using dimethylsulphoxide saturated with sulphur dioxide as a solvent for peptide synthesis. He also stressed the importance of avoiding racemization in the linking processes.

After a lively discussion, the final vote of thanks was proposed by Mr L. Munday, who organized the symposium.

PERKIN CENTENARY TRUST

The *Perkin Centenary Fellowship* is offered for one or two years for the purpose of higher study of an approved subject. Candidates will be required to show either that they have had experience in an industrial firm or other instituion concerned in the manufacture or application of colouring matters, or that their intended field of study has a direct bearing on these subjects. The value of the Fellowship is £750 per annum with an additional grant of up to £100 towards certain designated expenses; it is tenable from October, 1961, at any approved university, technical college or other institution.

Two *Perkin Centenary Scholarships* are offered, each for two years from October, 1961, and renewable at the discretion of the Trustees, to enable candidates employed in an industrial firm or other institution concerned with the manufacture or application of colouring matters to receive an education at a university or technical college. Each award will have a value of £350 per annum. There is no means test, and a successful candidate is not debarred from receiving the whole or a part of his normal salary from his employers during his tenure of the Scholarship.

Applications for *Perkin Centenary Trust Travel Grants* are invited from teachers concerned with the study of any aspect of the manufacture or application of colouring matters at a university, technical college or other institution. Grants will be obtainable towards the cost of travel and maintenance for 1-3 months.

Further details and application forms may be obtained from the secretary of the Trust, c/o The Chemical Society, Burlington House, London, W.1. The closing date for the receipt of applications is 1 May, 1961.

Book Reviews

CHEMICAL AND NATURAL CONTROL OF PESTS. E. R. de Ong. Pp. viii + 244. *New York: Reinhold Publishing Corporation; London: Chapman & Hall Ltd*, 1960. 60*s*.

At the recent meeting of the British Association, it was stated that the population of the world may reach 6,000 million by A.D. 2000, and this will necessitate more than doubling the present production of cereal and increasing animal products two to three times. In this connection the science correspondent of *The Observer* (4 September) wrote: 'There is every incentive for an aspiring scientist to devote his life to rockets or electronic computers and very little incentive to go in for locust control or soil chemistry. . . . New States have been showing disturbing signs of measuring scientific status by the possession or non-possession of a small atomic reactor.' Dr de Ong's book, which is written in a pleasant, straightforward style, deserves to find its way into the hands of many 'aspiring scientists,' and the references to sources of information render the volume of value to the more experienced worker in pest control. The introductory chapter (pp. 18) gives a general outline of the part played by insects, plant diseases, weeds, rodents and natural control agents in crop production. The subject is then treated in two sections. Part I (pp. 34) deals with the natural control of pests—insects, parasites and predators—insect diseases and the development of resistant plants. There is a most useful summary (pp. 34-41) of the effects of the better-known pesticides on beneficial insects and vertebrates. Part II (pp. 145) is concerned with the chemical control of insects, plant diseases, weeds and rodents. The advent of DDT, dithiocarbamates, 2,4-D and warfarin led to new conceptions of the degree of control of pests possible by the use of chemicals and, even more important, the commercial success of these discoveries provided the stimulus to the intensive search for new pesticides which has marked the past 15 years. In this account the results when these advances are translated into practice become apparent. The repercussions of the development of tolerance toward some of the newer insecticides by certain types of insects are discussed with skill and restraint at appropriate points in the book. Finally there is a useful appendix (pp.4) listing the chemical names of the pesticides referred to in the text.

The author is at pains to provide a well-balanced background to the subject. Thus, although a good deal of emphasis is laid upon the importance of the natural control of pests, the author underlines the necessity of using chemicals to provide the degree of control, particularly of insects and plant diseases, required to attain high yield and quality of crop production. At the same time the consequences of excessive use of the more toxic and persistent chemicals are not evaded, *viz*. the risks of almost complete extinction of the beneficial insect population in treated areas, and abnormally high residues on the produce. In spite of natural control forces and the great advances in control methods which followed the discovery of the chlorinated hydrocarbon and organophosphorus insecticides and the newer rodenticides, the annual losses from pests in the United States total 11-12 billion dollars. This sum gives point to the need for further extensive research and the desirability of attracting suitable graduates into the field.

The book is well printed and bound, and free from misprints—three only were detected—and the illustrations are well chosen. It would be advantageous in future editions to include an index of authors' names and a more comprehensive general index with some cross-indexing.

T. F. WEST

REPORTS ON PROGRESS IN PHYSICS. VOLUME XXIII. Edited by A. C. Stickland. Pp. iv + 629. *London: The Physical Society*, 1960. 63*s*.

The collection of review articles published annually by the Physical Society under the above title has a well-deserved reputation, both for the high quality of the papers and the range of material which each volume contains. Volume XXIII is no exception, since the ten articles include three on solid-state physics, two on spectroscopy, two on nuclear physics, and one each on the optical properties of thin films, planetary nebulae and photoelectric photometry.

L. Pincherle reviews the mathematical methods which have been adopted in making calculations of the electron energy-band structures of solids, and points out that the main problems at present are the construction of a satisfactory crystal potential (more difficult for insulators and semi-conductors than for metals) and the achievement of reasonable self-consistency. D. F. Johnston introduces group-theory and the application of group-theoretical methods in solid-state physics to the solution of problems such as the calculation of the eigen values of many-electron systems, and draws attention to the fact that the application of group-theory, by using the symmetry properties of operators, allows the best use to be made of the time available on computing engines. Metals are a special type of solid, and the nature of the Fermi surface, which accounts for many of their transport and other phenomena, is of great interest; much of the work in recent years in this field has been carried out at the Cavendish Laboratory, and the article by A. B. Pippard on the experimental analysis of the electronic structure of metals is a first-hand account of a great deal of it.

In spectroscopy, new developments in interferometric methods are dealt with by P. Jacquinot, and shorter wave-lengths in γ-ray spectroscopy are covered by G. A. Bartholomew and others. The use of the ^{3}He ion as a nuclear projectile for inducing nuclear reactions is

discussed by D. A. Bromley and E. Almqvist, and R. Bouchez and P. Depommier give an account of the general properties of capture of an orbital electron by the nucleus, a process which is important in the decay of many isotopes.

The book is produced in accordance with the high standards we have come to expect of this series, and is a worthy addition to the previous 22 volumes.

J. A. CATTERALL

DEUTSCHE EINHEITSVERFAHREN ZUR WASSER-, ABWASSER- UND SCHLAMMUNTERSUCHUNG. Fachgruppe Wasserchemie in der Gesellschaft Deutscher Chemiker. Pp. 88. *Weinheim: Verlag Chemie GmbH*, 1960. DM 20.

This publication is part of the third edition of methods for determining constituents in water, effluents and sludge, compiled by a group of German experts. It is similar in scope to *Methods of Chemical Analysis as applied to Sewage and Effluents* published recently by H.M.S.O. and to *Recommended Methods for the Analysis of Trade Effluents* compiled by the joint A.B.C.M.–S.A.C. Committee.

In order to allow for the incorporation of new methods and the deletion of old ones, a loose-leaf system has been adopted and the binder supplied is large enough to contain descriptions of subsequent chemical and bacteriological methods, which, it is stated, will be issued shortly.

Methods of physical examination are given first, followed by a comprehensive account of the monitoring of waters and effluents for β-activity. The following determinations are then described : sulphite, sulphide and thiosulphate; cyanide and thiocyanate; copper, zinc and nickel; silica; dissolved oxygen; hydrocarbons; phenols; grease; and sugar and starch.

For the most part the determinations are the same as those recommended in the above-mentioned British publications, but the following differences may be noted. In the determination of sulphide, cadmium acetate is used instead of the more usual zinc acetate, and a method is also given by which small amounts of sulphide may be determined colorimetrically as lead sulphide by the addition of lead acetate solution. For concentrations of copper above 5 mg/l electrolytic deposition is advocated, or precipitation with quinaldinic acid. This reagent is also recommended for the gravimetric determination of zinc above 10 mg/l; for larger amounts titration with EDTA is adopted. For phenols the Fox and Gauge method is modified by the use of *p*-nitraniline instead of sulphanilic acid.

The methods are adequately described, including, in many instances, a short account of the theory involved. References to literature are given, but mostly from German sources. The publication is well produced and should prove of interest to those engaged in water and effluent analyses.

W. G. CAREY

PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON MICROCHEMISTRY. (Organized by the S.A.C. under the patronage of IUPAC.) Pp. xxvi + 583. *London: Pergamon Press Ltd*, 1959. 100*s*.

The Symposium on Microchemistry held at Birmingham in August, 1958—organized by the Midland and Microchemistry Group of the Society for Analytical Chemistry, sponsored by IUPAC—was indeed international in character, with participants from many countries. The Proceedings have now been published in book form.

The first session (on qualitative microanalysis) commenced with a plenary lecture by Fritz Feigl on pyrolysis activated reactions. This work is an extension of Feigl's spot tests, but may be employed with advantage in many fields. 'Specific and Selective Organic Reagents' by Welcher (U.S.A.) contains many new features concerning the theoretical basis behind the search for specific reagents and is of considerable value to workers engaged in such applications. West (U.S.A.) contributes a useful section on practical applications of chemical microscopy, and recent developments in the ring oven are discussed by Weisz (Austria). The section on destruction of organic matter contains contributions by Diehl and Smith (U.S.A.) on the use of perchloric acid in wet oxidations, and by Pijck, Hoste and Gillis (Belgium) on radiochemical investigation into losses of trace elements during mineralization of organic matter. Weighing is dealt with by Hodsman and M. Corner (Great Britain).

There is a large section in the publication on the determination of elements and groups, and amongst the many contributions two papers may be singled out, one by Schoniger (Switzerland) on his flask combustion technique, and the other on the use of the oxy-hydrogen blast burner by Levy (France). An interesting paper by Sobotka (Austria) on the determination of physical constants is included. The section on biochemical methods includes some new and useful techniques, for example, microbiological assay of vitamins, antibiotics and amino acids (Adamson and Simpson, Great Britain) and the use of fungi to determine trace metals (Nicholas, Great Britain).

Chromatography, ion exchange, polarography, radiochemistry and spectrochemical methods were included in the Symposium, and applications suggested by well-known specialists. The various micro aspects of titrimetry and complexometry were likewise dealt with, and a series of papers by Haslam, Chirnside and Whalley (Great Britain) on the industrial applications of microchemistry are included.

The above account must be considered as an index, rather than a review, but sufficient can be seen from the contents of the publication to indicate the very wide scope of the Symposium and the high standard of the contributions.

I am of the opinion that this volume is a 'must' for all analysts, micro or otherwise, and congratulations must be given to all concerned in its publication for making it available, and at so reasonable a price.

R. F. MILTON

PLASTICS TODAY. A. Allcott. Pp. xi + 115. *London: Oxford University Press*, 1960. 18*s*.

The influence of the plastics industry on our changing pattern of living has become progressively more important, especially since the second world war. This book is therefore a welcome addition to the well-known series, 'The Pageant of Progress'.

After carefully selecting his material, the author has produced a most interesting account of the plastics industry. A brief outline of the development of the industry precedes a discussion on the nature of plastics and a moderately detailed review of plastics technology. The more important and familiar products of the industry are described in detail. Unusual plastics, such as bouncing putty and PTFE, are considered under a separate heading. Some of the more specialized applications of plastics receive detailed attention, including those of expanded plastics, potted circuits and printed circuits. The various terms used in the industry are carefully explained and the text is illustrated both by line diagrams and by a selection of well-chosen photographs. The final chapter, entitled 'Openings and Careers in the Plastics Industry', is compiled from information supplied by the Plastics Institute and contains much that enhances the usefulness of this book.

Plastics Today can be used as a guide to the plastics industry by readers with little knowledge of chemistry. It is not intended to be a textbook, and although aimed at the general reader it should provide the intending entrant to the industry with a clear picture of the scope of the industry and of his prospects in it. It should prove to be a popular addition to many school libraries. However, it is unfortunate that much that might appeal to prospective chemists has been omitted.

B. E. DAWSON

INSULIN. Scientific Editor, F. G. Young. (*British Medical Bulletin*, 1960, **16**, No. 3.) Pp. xvi + 175-264. *London: The British Council*. 20*s*.

This number of the *British Medical Bulletin* displays attractively how insulin still represents one of the most satisfying applications of chemistry in medicine. Its 17 papers include accounts of the preparation, chemistry and determination of insulin, its action and clinical use, and details of the relatively simple synthetic substances which lower blood glucose and can in some circumstances be used in place of insulin.

The two opening papers have the status of historical documents: that of C. H. Best recounts the work at Toronto which led to the first satisfactory insulin preparations in 1921; that of F. Sanger describes his elucidation of the structure of insulin. Details of *how* insulin has its effect are still only partially settled, but the wealth of available information on its action in the metabolism of carbohydrates, fatty acids and protein is well appraised by R. B. Fisher, S. J. Folley, A. L. Greenbaum, A. Korner, K. L. Manchester, P. J. Randle and F. G. Young. The status of insulin or insulin-like substances in the blood, their assay, and relationship to antagonists, antibodies and degrading enzymes are recounted by G. A. Stewart, A. J. Kenny, P. J. Randle, K. W. Taylor, J. Vallance-Owen and P. H. Wright. These subjects make the closest approach to the nature of diabetes. W. Oakley subsequently describes the use of insulin in clinical practice, giving details of undesirable side-effects and of different insulin preparations.

Even before the isolation of insulin, a number of relatively simple substances were already known to lower blood glucose and to ameliorate some categories of diabetes. R. F. Mahler describes these beginnings, and also the successful synthetic drugs which have been developed more recently.

The two main categories are diguanides (including dimethyldiguanide, $Me_2N{\cdot}C(NH){\cdot}NH{\cdot}C(NH){\cdot}NH_2$ and phenylethyldiguanide) and sulphonylureas (carbutamide, $H_2N{\cdot}C_6H_4{\cdot}SO_2{\cdot}NH{\cdot}CO{\cdot}NH{\cdot}(CH_2)_3{\cdot}CH_3$ and congeners); they have the virtue of acting when given by mouth. Their clinical effectiveness in specific categories of diabetes is described by J. D. N. Nabarro.

The papers as a whole are of the authoritative standard associated with the *Bulletin*, and their chemical and other aspects are excellently documented.

H. MCILWAIN

EXTRACTIVE AND PHYSICAL METALLURGY OF PLUTONIUM AND ITS ALLOYS. Edited by W. D. Wilkinson (Metallurgical Society of AIME.). Pp. x + 314. *New York: Interscience Publishers Inc.; London: Interscience Publishers Ltd*, 1960. 79*s*.

This volume is an edited version of papers presented at a Symposium on the Extractive and Physical Metallurgy of Plutonium and its Alloys. The Symposium, sponsored by the Metallurgical Society of the American Institute of Mining, Metallurgical and Petroleum Engineers, was held in San Francisco in February, 1959, and 14 papers were given—one from Britain, two from France and the rest from the U.S.A. (with two exceptions these came from the Los Alamos Scientific Laboratory). This distribution of papers was, no doubt, influenced by the location of the Symposium.

The extractive metallurgy section includes papers (British, American and French) on methods for the conversion of plutonium compounds to metal, methods for the preparation of plutonium halides, and data on the separation of plutonium from impurities by solvent extraction processes employing tributyl phosphate and by extraction in fused-salt systems. In the physical metallurgy section, some principles are developed for the alloying behaviour of plutonium, and specific examples are given of the plutonium–cerium and plutonium–zinc systems. The metallography of α-plutonium is dealt with in a French paper and the transformation kinetics of α-, β- and γ-plutonium are detailed in a paper from Hanford. Techniques are described for zone-refining plutonium and for etching it and its alloys by cathodic bombardment. The behaviour of certain δ-stabilized plutonium alloys at high pressures is also treated.

This book undoubtedly contains a wealth of important and technically valuable data, both on the preparation of plutonium and on the physical metallurgy of the metal and its alloys. Nevertheless, the claim voiced in the introduction that this is 'the first published book devoted solely to plutonium metallurgy' has no intrinsic merit, particularly since the volume is not a complete work. A well-written and critical monograph containing much of the data presented in this volume, as well as the large amount of material released at the Geneva and other Conferences and in the published literature referred to in the bibliography, would be of much more permanent value. The present volume will come into this category only for the best of the papers it contains and most of these are in the physical metallurgy section—the papers on principles of alloying behaviour and on phase transformation kinetics being particularly valuable.

General criticisms may be made of the extractive metallurgy section. For example, each paper on the preparation of plutonium metal contains much that is common to all and little of essential value that has not already been published. The papers on solvent extraction and pyrometallurgical processes for plutonium purification might, more appropriately, have been presented at one of the many chemistry conferences dealing with this subject. The bibliography could also be criticized on the grounds that if American metallurgists continue to include physical, inorganic and even organic chemistry under the title 'Hydrometallurgy,' then this section of the bibliography is only fractionally complete.

A few specific points might be mentioned. On page 10 it is stated that the minimum critical mass of plutonium metal is 'somewhat less than 300 g when in a reflected solution.' On the basis of other unclassified data (*e.g.* Callihan, T.I.D. 7016) the above value appears to be low and probably includes a factor of safety. On page 26, methods for preparing plutonium metal by fused salt electrolysis are dismissed in a somewhat arbitrary manner when, in fact, a close analogy could have been drawn with the preparation of pure uranium metal by such methods and, as Brodsky has subsequently shown (Grenoble Conference 1960), these provided plutonium metal of a higher purity than could be obtained by most other routes.

More critical editing might also have improved the form of presentation in some papers, for example on page 76: 'A stock solution of solvent was prepared by mixing 35 volumes of Commercial Solvent Corporation's tri-n-butyl phosphate with 65 volumes of Gulf Oil Corporation's Gulf Solvent BT.' There are several such expressions that savour a little of commercial television and tell the reader nothing of the quality of the reagents. Fundamental objection could also be raised to the method quoted on the same page for the determination of trivalent plutonium by extraction of the equilibrium concentration of the tetravalent form by thenoyl-trifluoroacetone. Spectrophotometric methods are preferable for systems in equilibrium. Care is also required in the use of the nitrite/nitrate couple to ensure maximum concentration of plutonium IV in equilibrium with plutonium III.

With reservations such as the above, and in spite of the fact that the valiant efforts of the editor have not entirely succeeded in making a composite whole of a diverse selection of papers ranging from aqueous chemistry to physical metallurgy, the contents of this volume can be recommended both to those who are new to the field and to those who have already had experience in it.

J. S. NAIRN

AN INTRODUCTION TO THE CHEMISTRY OF HETEROCYCLIC COMPOUNDS. R. M. Acheson. Pp. xiv + 342. *London: Interscience Publishers Ltd; New York: Interscience Publishers Inc.*, 1960. 35*s*.

The textbook literature of heterocyclic chemistry has been greatly augmented recently, for this is the third book on the subject to appear in the last two years. Surprisingly enough, the books by Albert, by Katritzky and Lagowski and by Acheson cannot truly be regarded as competing with each other. Of the three, Acheson's is most recognizably an 'Introduction.' It is on the whole conventional, and if it lacks the excitements of originality it enjoys the virtues of straightforwardness.

This book contains nine chapters: heterocyclic analogues of cyclopropane (azirine, aziridine, oxirane, thiirane, oxazirane); heterocyclic analogues of cyclobutane (azetidinones, azetidine, oxetane, oxetanones, thietane); heterocyclic analogues of cyclopentadiene with one heteroatom (pyrrole, furan, thiophene); fused-ring systems involving pyrrole, furan and thiophene rings (indole, isoindole, pyrrocoline, benzofuran, dibenzofuran, isobenzofurans, thianaphthene); heterocyclic analogues of benzene with one heteroatom (pyridine, pyrylium salts and pyrans); heterocyclic analogues of napththalene with one heteroatom (quinoline, isoquinoline, quinolizine,

acridine and phenanthridine, benzopyrylium salts and benzopyrans); compounds with two heteroatoms in a five-membered ring (pyrazole and imidazole, isoxazole and oxazole, isothiazole and thiazole, dioxole, dioxolane, and their sulphur analogues); compounds with two heteroatoms in a six-membered ring (pyridazine, pyrimidine, pyrazines, oxazines and thiazines, dioxanes and their sulphur analogues); some compounds with more than two heteroatoms (purines, pteridines, triazines, sydnones). There is also a compound index and a subject index.

The author of an 'Introduction' is always faced with the impossible problem of what to do about references. In this book references are given to reviews, textbooks and original literature, but one can reasonably complain of lack of proportion when Chapter II (pp. 17) gets seven general and 34 primary references, whilst Chapter IV (pp. 33), which deals with a more extensive topic, has six general and 26 primary references. However, the general references are always valuable, and the journal references, if unavoidably unbalanced, are provided to some extent.

Any specialist could find something to quarrel with in this book, and although on the whole it seems very sound, there are some general faults which must be mentioned. The frequent references to electron-density diagrams (about which there is a flat mis-statement on p. 217) are uncritical and could lead the beginner to a false impression of their value. The same is true of the now not-so-popular resonance energies. On the other hand, qualitative electronic theory and the discussion of reaction mechanisms are not used as much as they should have been. It is this, and a general lack of stress on things 'physical,' which gives the book its conventional flavour. There is not a single ultra-violet or infra-red extinction curve in the book. Ionization data are sometimes quoted as equilibrium constants, K_b or K_a, sometimes as pK_a.

These deficiencies, and also a carelessness on the part of the author over the transitive or intransitive character of such verbs as 'to sulphonate,' detract from the quality of the book. Nevertheless, despite these shortcomings, the book is as satisfactory an 'Introduction' as we have yet had. It is very well produced, and moderately priced.

K. SCHOFIELD

APPLIED GAMMA-RAY SPECTROMETRY. INTERNATIONAL SERIES OF MONOGRAPHS ON ANALYTICAL CHEMISTRY. VOLUME 2. Edited by C. E. Crouthamel. Pp. xii + 443. *London: Pergamon Press Ltd*, 1960. 50*s*.

This is a practical book, intended by the authors to present to non-specialists the means of using γ-ray spectrometry in fields other than nuclear physics, and of interpreting the results obtained: chemists, biologists and engineers are specifically mentioned in the preface.

The main text, in four chapters, occupies just over one-third of the book, the remainder being devoted to appendixes comprising tables of practical value and including a 144-page compilation of γ-ray spectra as obtained with scintillation counters.

A short introduction outlines the historical development of the scintillation counter and the proportional counter as γ-ray spectrometers, and mentions possibilities of other detectors for this purpose.

Chapter 1, entitled 'Intrinsic Variables,' states the radioactive decay processes and the laws governing the interaction of radiation with matter, on which the technique is based. In 24 pages this is a formidable task, and the non-specialist may find it tough going. Generally the presentation is clear and references plentiful, but a comparison of *bremsstrahlung* and pair production processes is liable to confuse rather than help.

Under the enigmatic title of 'Extrinsic Variables' the next chapter begins with an analysis of scintillation spectrometer statistics, marred by a certain confusion of symbols, but goes on to provide a wealth of practical design and testing information for scintillation counters. It shows an impressive mastery of the subject, and even gives detailed instruction in the machining and packaging of sodium iodide phosphors. The information on proportional counters is scanty by comparison, but a practical design is shown, together with essential data and examples of X-ray spectra obtained.

A short chapter deals with the calibration of efficiencies of scintillation counters. Finally Chapter 4, 'Specific Applications,' gives an excellent and practical review of scintillation spectrometry in radioactivation analysis, but little else. As a result, this valuable and instructive account ends, as it were, in a minor key.

The book could be justified by its appendixes alone. Tables of X-ray absorption energies and K and L spectra are followed by the compilation of gamma-ray spectra, an extensive table of intrinsic efficiencies of cylindrical NaI (Tl) crystals and three tables of the nuclides, arranged in order of photon energy, atomic number and half-life. The value of these appendixes to non-specialist and specialist alike can hardly be overestimated; in particular, the exhaustive collection of 256 spectra from ^{7}Be to ^{241}Am is invaluable for identification and interpretation of experimental spectra (even though strong eyesight is needed to read some of the reduced-scale printing). This being so, a little more introductory material in the appendixes themselves would have been welcome, for example, to state the significance of absorbers quoted in the captions. Captions are missing from more than half the diagrams. This, and the inadequacy of the index, is unfortunate in a book that will undoubtedly be used for reference.

The book fulfils a real need for a systematic presentation of the subject and is likely to stand for some years as a reference work.

J. L. PUTMAN

Institute Affairs

ANNUAL CONFERENCE, SOUTHAMPTON

20-22 April, 1961

In response to an invitation from the Officers and Committee of the Mid-Southern Counties Section arrangements have been made for the 1961 Annual Conference of the Institute to be held in Southampton during the three days Thursday-Saturday, 20-22 April.

One of the important features of the Conference will be an all-day Symposium on 'Chemicals from Petroleum' to be held on Thursday, 20 April. The Annual General Meeting will be held at the University of Southampton on the Friday morning, after which an Address will be given by Sir Harold Hartley, G.C.V.O., C.B.E., F.R.S., *Honorary Fellow*. An announcement, with an outline of the Programme of Events, is being circulated to Fellows, Associates and Graduate Members with this issue of the *Journal*.

Every member who hopes to attend the Conference is asked to **complete the questionnaire form** and return it to the office of the Institute **immediately,** even if there is a possibility that other commitments may prevent attendance.

As space and seating accommodation are limited, it will be necessary to restrict attendances at certain events. If the demand for tickets exceeds the number available, priority will be given to those who previously returned the questionnaire forms, if necessary in order of receipt.

On this occasion, the detailed **Programme of Events,** registration forms and other detailed information **will be sent,** in January, 1961, **only to those members who have returned the questionnaire forms,** and not, as hitherto, to all members in Great Britain and Ireland.

Further particulars will be sent, on request, to any member resident overseas who expects to be in England next April.

NEW HONORARY FELLOWS

At its meeting on 21 October the Council formally elected two distinguished men of science to the Honorary Fellowship, namely:

Sir ERIC ASHBY, M.A., D.SC., HON.SC.D., HON. LL.D., D.I.C.

Sir JOHN RUSSELL, O.B.E., D.SC., F.R.S.

Sir ERIC ASHBY seems to have lived several lives simultaneously. A product of the City of London School and of Imperial College, he also studied at the University of Chicago and the Desert Laboratory of the Carnegie Institution. He then held a number of academic appointments as a botanist at Imperial College, London, and at the Universities of Bristol, Sydney and Manchester until 1950. From 1950 to 1959 he was President and Vice-Chancellor of Queen's University, Belfast, and is now Master of Clare College, Cambridge. He has also been Chairman of the Australian Chemical Research Council (1940-42) and was Councillor and Chargé d'Affaires at the Australian Legation at Moscow in 1945-46. Indeed, during and since World War II he has held numerous honorary offices of a national character and has been a member of the Advisory Council on Scientific and Industrial Research since 1954 and Chairman of the D.S.I.R. Postgraduate Grants Committee since 1956. He has translated botanical works from German, written books about food shipment from Australia in wartime, about his observations in Russia, on education and on the social impact of science. The value of his work for science, education and the nation was recognized by the conferment of a knighthood in 1956, and he has been awarded honorary degrees by the Universities of St Andrews, Aberdeen and Dublin, and the National University of Ireland.

Sir (Edward) JOHN RUSSELL's life interests are clearly shown in the titles of two of his latest books: *The Land Called Me* (which is an autobiography) and *The World of the Soil*. He was born in Frampton, Gloucestershire, in 1872, and studied at Aberystwyth, and afterwards at Manchester where he became a lecturer in chemistry. He was next head of the chemistry department at Wye College for several years before being appointed Goldsmiths' Company's soil chemist at the Rothamsted Experimental Station, where he stayed for some 37 years, 32 of them as Director of the Station and (from 1928) of the Imperial Bureau of Soil Science. He was admitted F.R.S. in 1917, appointed O.B.E. in 1918 and created a Knight in 1922. He has been honoured with several medals of learned societies and university degrees, and admitted to membership of numerous foreign academies. During the First World War he carried out important work in food production and in the Second was chairman of U.N.R.R.A's Agriculture Sub-committee. He has written more than a dozen books—for students, experts, farmers and the general reader.

POSSIBLE NEW GRADE OF MEMBERSHIP

Since the Council's Statement on 'Possible new grade of membership and category of affiliation' was published in April (*J.*, 122-125), views on various aspects of the subject have been expressed at meetings of Local Sections or their Committees and at other meetings, as well as by individual members in correspondence.

The Study Group on Qualifications concluded, from an examination of the relevant reports and communications, that the views expressed indicate widespread support, in principle, for the establishment of a Licentiateship grade of membership, but practically no support for the formation of a Registered Chemical Assistants Group affiliated to the Institute. The Council has therefore decided to proceed with the elaboration of proposals for the suggested Licentiateship

grade but not to proceed, at least for the time being, with any further consideration of an affiliated Group.

Although possible provisions for establishing a Licentiateship grade were outlined in the Statement published in April, several points of principle, as well as many of detail, were then left open. These are now being studied in the light of the comments and suggestions received, especially those from Local Sections (*see* also the Report of the recent Conference of Hon. Secretaries of Local Sections, p. 405). It is recognized that some controversial issues still require examination, and that the acceptability of the Licentiateship provisions to the general body of corporate members may depend on how they are resolved.

Whatever steps may be taken to sound the opinion of members at any stage, the ultimate decision on whether to establish a Licentiateship grade cannot be made until the necessary changes in By-laws are submitted for approval by a Special General Meeting. Thus, although it is the desire of the Council to arrive at a settlement of this problem as soon as possible, it should not be assumed that this can be achieved in less than three months; nor should the outcome be pre-judged. In any event, members will be kept informed of developments through these columns.

EXAMINATIONS, SEPTEMBER, 1960

Graduate Membership, Part II

Examiners: Professor C. W. Davies, Professor W. G. Overend, Dr A. G. Sharpe

Assistant Examiners: Mr E. A. W. Hebdon, Dr A. D. Mitchell

The examination was held at the University of Birmingham, the Royal College of Science and Technology, Glasgow, and the University of London, the theoretical papers being taken also at various local centres, in the periods 5–10 and 13–16 September.

The total number of candidates was 185, of whom 54 passed (29·2 per cent).

Of the 185 candidates taking Part II, 15 candidates followed full-time courses (five passed; 33·3 per cent), eight attended 'sandwich' courses (six passed; 75·0 per cent), 69 attended part-time courses preceded or followed by a period of full-time or 'sandwich' study (25 passed; 36·2 per cent), 93 trained wholly by means of part-time courses (18 passed; 19·3 per cent). Of all the candidates 54 had previously passed Part I, of whom 32 passed Part II (59 per cent); 31 had been exempted from Part I under Regulation F3, of whom 11 passed Part II (35 per cent.); 18 had been exempted from Part I under Regulation F4, of whom five passed Part II (28 per cent).

Thus of the 54 candidates who passed Part II, 48 had either passed Part I or had been exempted under the current Regulations (89 per cent).

PASS LIST

ADAMS, John Alexander, Central College of Further Education, Carlett Park, Eastham (Wirral)

ADOLPH, Colin William, Technical College, Hatfield; Chelsea College of Science and Technology, London

AINSWORTH, Leonard Ralph, B.SC.(SHEFF.), University of Sheffield; S.W. Essex Technical College, Walthamstow

ARMES, John Noel, S.W. Essex Technical College, Walthamstow

BARNETT, Gerald Wilton, College of Further Education, Slough

BAYLIS, Anthony Basil, Technical College, Birkenhead

BEDFORD, Colvin Frederick, Brunel College of Technology, Acton, London; Chelsea College of Science and Technology, London

BIGGINS, Robert, Constantine Technical College, Middlesbrough

BIRCH, Ronald Richard, Flintshire Technical College, Connah's Quay

BUTLER, Sidney Thomas, College of Technology, Leeds

CARTER, Colin Paddon, Technical College, Kingston (Surrey)

CHRISTIE, Ian Robert Arthur, Brunel College of Technology, Acton, London; Chelsea College of Science and Technology, London

CLARK, George Francis, B.SC.(LIV.), S.E. Essex Technical College, Dagenham; University of Liverpool; S.W. Essex Technical College, Walthamstow

COSTLEY, Brian David, B.SC.(LOND.), Wolverhampton and Staffordshire College of Technology, Wolverhampton

CUTHILL, Ian David Heggie, Technical College, Dundee; Technical College, Gloucester; Battersea College of Technology, London; Sir John Cass College, London

DALE, Anthony Richard, College of Further Education, Slough

DENVER, Robert John, Technical College, Paisley

DICHLIAN, Michael George, Northern Polytechnic, London

DIXON, Peter Frederick, B.A., M.B., B.CHIR.(CANTAB.), Battersea College of Technology, London

DROHAN, John James, Lanchester College of Technology, Coventry

EDWARDS, Arthur Dennis, Central College of Further Education, Carlett Park, Eastham (Wirral)

GORDON, David, Technical College, Paisley

GRAYSTON, Gerald Robert, The Harris College, Preston

GREBBELL, John, Northern Polytechnic, London

GRIGG, Ronald Ernest, Brunel College of Technology, Acton, London

HADDOCK, Ernest, College of Technology, Leeds

HEINEMANN, Miss Brigitte, B.SC.(LOND.), College of Technology and Commerce, Leicester; Chelsea College of Science and Technology, London; The Polytechnic, Regent Street, London

HEMINGWAY, Eric, College of Technology, Huddersfield

HUNT, David William, Northampton College of Advanced Technology, London

JARVIS, John Walter, Battersea College of Technology, London; Chelsea College of Science and Technology, London; Sir John Cass College, London

JENKINSON, Stuart Clifton, Rutherford College of Technology, Newcastle upon Tyne

MARKS, Michael Redding, B.S.(LOND.), S.E. Essex Technical College, Dagenham; Northern Polytechnic, London

MAXWELL, John Malcolm, Woolwich Polytechnic, London

MENDHAM, John, Woolwich Polytechnic, London

MUTEN, Ian Malcolm, Technical College, Kingston (Surrey)

NEWMAN, David John, Technical College, Birkenhead

NYE, Martin John, Technical College, Brighton

PARSONS, Derek George, Brunel College of Technology, Acton, London

PITT, Michael Charles, Battersea College of Technology, London; Northampton College of Advanced Technology, London

RATCLIFFE, Neil Thomas, College of Further Education, Slough

ROBERTS, John Lawrence, Chelsea College of Science and Technology, London

ROWLAND, Ronald, Wigan and District Mining and Technical College, Wigan

RUDD, Eric James, Lanchester College of Technology, Coventry

SANDON, Peter Thomas Sydney, Medway College of Technology, Chatham; Brunel College of Technology, Acton, London; College of Further Education, Whitehaven

SEERY, Kevin James Mary, Technical College, Birkenhead

SINCLAIR, Alexander, Royal College of Science and Technology, Glasgow; Technical College, Hatfield; Northern Polytechnic, London

SKRIMSHIRE, Anthony John Hamor, Brunel College of Technology, London

SMITH, John Royston, Sir John Cass College, London

SPEAKMAN, Kenneth, Constantine Technical College, Middlesbrough

SPILLANE, Geoffrey William, Technical College, Birkenhead; Woolwich Polytechnic, London

UMFREVILLE, John Herbert, The Polytechnic, Regent Street, London; College of Further Education, Slough

UPPERTON, Albert Michael, Battersea College of Technology, London

WATSON, Brian William, B.SC.(S'TON), Harris College, Preston; University of Southampton

WHITESIDE, Ian Robert, City College and Art School, Norwich

EXAMINERS 1960-61

The following schedule of examiners for 1960-61 replaced that published in July (*J.*, 251) upon the completion of the work relating to the September examinations.

Graduate Membership: Part I

C. C. ADDISON, PH.D., D.SC.(DUNELM.), F.INST.P.
C. W. DAVIES, D.SC.(WALES)
W. J. HICKINBOTTOM, PH.D., D.SC.(BIRM.)

Graduate Membership: Part II

W. G. OVEREND, PH.D., D.SC.(BIRM.)
A. G. SHARPE, M.A., PH.D.(CANTAB.)
W. F. K. WYNNE-JONES, B.SC.(OXON. AND WALES), D.SC.(WALES)

Diplomas in Applied Chemistry

Branch A: R. C. CHIRNSIDE; J. HASLAM, D.SC.(MANC.)
Branch B: R. A. MORTON, PH.D., D.SC.(LIV.), F.R.S.
Branch C: C. TYLER, B.SC., PH.D.(LEEDS)
Branch D: E. J. KING, M.A., PH.D.(TORONTO), D.SC.(LOND.); I. D. P. WOOTTON, M.A., M.B., B.CHIR.(CANTAB.), PH.D.(LOND.)
Branch E: T. MCLACHLAN, D.C.M., A.C.G.F.C., M.I.BIOL.; H. E. ARCHER, M.R.C.S.(ENG.), L.R.C.P.(LOND.)
Branch F: J. G. SHERRATT, B.SC.(MANC.)
Branch G: W. PRESTON, M.SC., PH.D.(LOND.), M.I.CHEM.E. (Examiners in the special sections of Branch G will be appointed as required.)

Assistant Examiners

A. D. MITCHELL, D.SC.(LOND.)
D. A. FRYE, B.SC., PH.D.(LOND.), A.R.C.S., D.I.C.

Special Examiners

H. V. A. BRISCOE, M.SC.(DUNELM.), D.SC.(LOND.), A.R.C.S., D.I.C.
J. R. NICHOLLS, C.B.E., D.SC.(LOND.)

NATIONAL CERTIFICATES AND DIPLOMAS

In each year since the end of the war increases in the numbers of candidates for National Certificates in Chemistry and Applied Chemistry, and of colleges operating courses for these awards, have been reported. This year is no exception, and, although the Ordinary National Certificate entry shows an advance of only about 6 per cent over 1959, there were almost 20 per cent more candidates for the Higher National Certificate. The numbers passing, however, did not keep pace. For the Higher National Diploma, too, more candidates came forward from more colleges. Endorsement subjects retained the popularity established in recent years. In all, 126 colleges submitted candidates in one or more grades.

The scheme in Scotland has for many years included provision for referment, and it has been agreed that similar arrangements should also be made for England

and Wales. In this first year of operation, 188 O.N.C., 74 H.N.C., and 2 H.N.D. students have been referred in a single paper. The results of this innovation will be watched with interest.

The results of the examinations are summarized below, the numbers in parentheses being the revised figures for the previous year.

	Entries	Passes
England and Wales		
O.N.C.	2,816 (2,667)	1,389 (1,502)
O.N.C. Endorsements ..	1,262 (1,294)	811 (841)
H.N.C.	1,599 (1,363)	979 (856)
H.N.C. Endorsements ..	132 (98)	93 (87)
H.N.D.	19 (9)	9 (8)
H.N.D. Endorsements ..	6 (6)	6 (6)
Scotland		
O.N.C.	378 (342)	198 (212)
O.N.C. Endorsements ..	147 (95)	98 (67)
H.N.C.	238 (184)	137 (102)
H.N.C. Endorsements ..	4 (4)	4 (4)
Northern Ireland		
O.N.C.	28 (34)	15 (14)
O.N.C. Endorsements ..	2 (0)	2 (0)
H.N.C.	3 (2)	2 (2)

Of the above, 20 Ordinary and 20 Higher National Certificates, and 4 Higher National Diplomas, were awarded in Applied Chemistry.

Nomination of District Members of Council.—With reference to the notice published last month (*J.*, 366), the attention of Fellows and Associates is called to the **revised Schedule of Districts** that became effective in 1959–60 (*see J.*, 1958, 667).

Representation on other Bodies.—The following appointments were made by the Council at its meeting on 21 October (*cf. J.*, 252):

The Poisons Board (Pharmacy and Poisons Act, 1933): Dr Frank Hartley for a further period of three years, from 1 November, 1960.

The Chemical Council: Mr Clifford Paine (in succession to Dr C. C. Hall) for a period of three years from 1 January, 1961.

British National Committee for Biochemistry (Royal Society): Professor Leslie Young (in succession to Professor C. H. Gray) for a period of six years from 1 January, 1961.

British National Committee for Chemistry (Royal Society): Mr George Dring (in succession to Mr R. C. Chirnside) for a period of six years from 1 January, 1961.

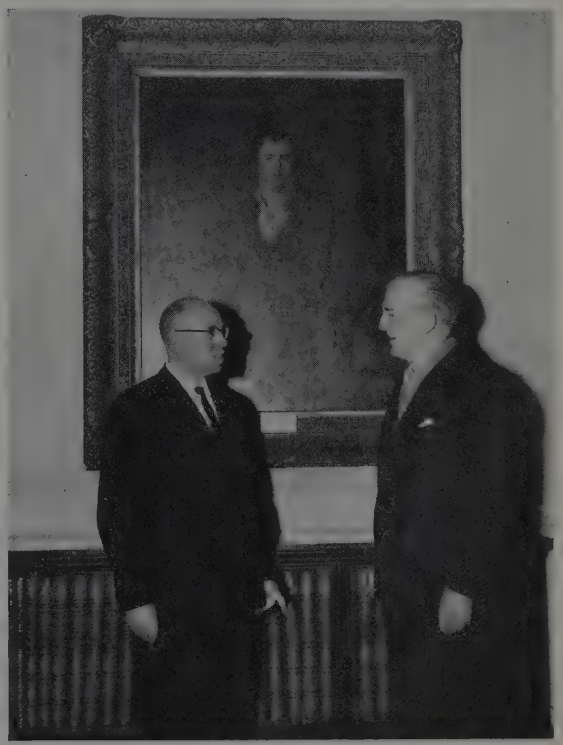
Technical College Committees.—The following members have been nominated by the Council to serve as Institute representatives on science advisory committees of technical colleges: East Ham Technical College, Dr R. J. Wicker, *Fellow*; Slough College of Further Education, Miss E. I. Beeching, *Fellow*, in succession to Mr H. T. Islip; Stockport College for Further Education, Dr M. I. Gillibrand, *Fellow*, in succession to Dr A. F. Daglish.

Register of Fellows and Associates, 1960.—Those members who have not yet completed and returned the card sent recently are urgently requested to do so forthwith. In order to avoid delays in publication, **no guarantee can be given that returns received after 30 November will be included.**

If any member does not return a card it will not be possible to include in his entry any letters denoting corporate membership of qualifying bodies other than the R.I.C. or any reference to occupation or telephone number, but the registered address will be given.

SECOND HUMPHRY DAVY LECTURE

On the evening of 12 October, at the Royal Institution, the Chair was taken by the President, Mr E. LeQ. Herbert, for the Second Humphry Davy Lecture of the London Section, given by Professor V. N. Kondratiev,



Professor Kondratiev (*left*) speaks with the President under the portrait of Davy before the lecture

of the U.S.S.R. Academy of Sciences, on 'Energy Exchange in the Interaction of Particles under Electric Discharge.'

He dealt mainly with the results of mass spectroscopic studies of the interactions of ions and neutral atoms and

molecules, which play an important part in electric discharge, flames, radiation-induced reactions, catalytic processes and other fields. Several systems were described in detail, and the contributions of British workers in this field were mentioned.

The lecture will be published next month in the series of *Lectures, Monographs and Reports*.

PERSONAL NOTES

News of Hon. Fellows

H.R.H. The Prince Philip, Duke of Edinburgh, has become Patron of the Society for Visiting Scientists (*see* p. 381).

Sir John Cockcroft, O.M., *Nobel Laureate*, was formally admitted as Master of Churchill College, University of Cambridge, at its inaugural meeting recently. Sir John opened the new physics building of the Imperial College of Science and Technology, London, on 20 October.

Honours and Awards

Dr G. Jones, *Associate*, of the Rowett Research Institute, Bucksburn, Aberdeenshire, has been awarded the Sophie Fricke Royal Society Research Fellowship, tenable at the Rockefeller Institute, for the academic year 1960–61. Dr Jones will work on the fractionation and characterization of leaf proteins.

Dr R. Stevenson, *Associate*, has been awarded the degree of Doctor of Science by the University of Glasgow, and now holds the position of Associate Professor of Chemistry at Brandeis University, Waltham, Massachusetts.

Consultant

Dr B. S. Gidvani, *Fellow*, has set up an independent consulting practice in resins, paints, varnishes, lacquers and other surface coating materials at 24–5 Cheyne Place, Chelsea. Tele: FLAxman 9366.

Educational

Dr J. W. ApSimon, *Associate*, formerly of the department of organic chemistry, University of Liverpool, is now with the division of pure chemistry, National Research Council, Ottawa.

Dr Rosa Augustin, *Fellow*, is now at the Liverpool School of Tropical Medicine. She was formerly at the Wright-Fleming Institute of Microbiology, St Mary's Hospital Medical School.

Mr R. L. Forman, *Associate*, formerly a technical chemist with the Shell Chemical Co. Ltd, is now at the Medway College of Technology, Chatham.

Mr N. A. Hampson, *Associate*, formerly senior works chemist of Chloride Batteries Ltd, Manchester, has taken a post at Loughborough College of Technology.

Mr F. L. Hulbert, *Fellow*, was awarded a University of London Convocation Trust Book Prize on his results in the Intermediate Examination in Laws this summer. These prizes are awarded to encourage external students of the University at the intermediate or Part I stage of certain degree courses.

Dr H. H. G. Jellinek, *Associate*, vice-chairman and professor in the department of chemistry, Essex College, Assumption University of Windsor, Ontario, has been appointed chairman of the department.

Dr R. E. Johnstone, *Fellow*, has resigned from the U.K.A.E.A., Springfields, and accepted an appointment as Professor of Chemical Engineering at the University of Nottingham.

Dr A. L. Misra, *Associate*, formerly a research associate in the department of pharmacology, University of Michigan Medical School, is now at the division of biophysics, Central Drug Research Institute, Chattar Manzil, Lucknow, India.

Mr T. Narasimha Murthy, *Associate*, has taken a post as lecturer in applied science, Government Polytechnic, Kottayam, Kerala, India. He was formerly head of food technology, Kerala Government Polytechnic, Calicut.

Dr S. M. Nelson, *Associate*, formerly of the Du Pont Co. (U.K.) Ltd, Londonderry, is now at the Queen's University of Belfast.

Dr J. S. Rowlinson, *Fellow*, senior lecturer in chemistry, University of Manchester, has been appointed to the chair of chemical technology, University of London, tenable at the Imperial College of Science and Technology.

Dr P. C. Shah, *Associate*, is now at the School of Veterinary Medicine, University of Pennsylvania. He was formerly at the School of Medicine, University of California.

Dr J. C. J. Thynne, *Associate*, has returned to this country from the University of California, and is now at the University of Leeds.

Dr M. G. H. Wallbridge, *Associate*, has returned to England to take up an I.C.I. Research Fellowship at the University of Nottingham. He was formerly with the Research Council of Alberta, Edmonton, Canada.

Mr J. Wilson, *Associate*, formerly chemical adviser, Fire Protection Association, is now assistant lecturer in inorganic chemistry at East Ham Technical College.

Academic Visitors to the United Kingdom.—The following members of staff of oversea Commonwealth universities are expected to be in the U.K. until the dates stated: Dr J. W. Clark-Lewis, *Fellow* (Adelaide), June, 1961; Dr V. V. Deshpande, *Associate* (Bombay), 1961; Dr S. K. Mukerjee, *Associate* (Delhi), September, 1961; Mrs W. P. D. Pereira, *Associate* (Ceylon), September, 1961; Mr T. Thirunamachandran, *Associate* (Ceylon), September, 1961; Dr D. Vir, *Associate* (Panjab), January, 1962.

Staff College for Technical Teachers.—Sir David Eccles, Minister of Education, has announced the names

of the first Governors of the proposed Staff College for technical teachers. Sir Alexander Fleck, K.B.E., F.R.S., *Fellow*, will be the chairman of the Governing Body. Among the members is Dr R. W. Bolland, *Fellow*, head of the department of chemistry and biology, Bristol College of Science and Technology.

Public and Industrial

Mr R. C. Agabeg, *Associate*, has been appointed product manager, imported chemicals, chemicals division, Union Carbide Ltd.

Dr A. R. Anderson, *Associate*, formerly of the chemistry division, Argonne National Laboratory, Illinois, is now with the chemistry division, Atomic Energy Research Establishment, Harwell.

Mr F. Ashworth, *Associate*, has been appointed works manager of Reddish Chemical Co. Ltd, Cheadle Hume, Cheshire. He was formerly production manager of Wm Blythe & Co. Ltd.

Mr A. E. Billington, *Associate*, is to take charge of product research work at H. W. Carter & Co., Coleford, a subsidiary of Beecham Foods Ltd.

Mr A. H. Broadhurst, *Associate*, has been appointed Deputy Director of Army Contracts, The War Office.

Mr R. W. Brockett, *Associate*, is now chief chemist, Chemical Building Products and Hemel Laboratories Ltd.

Dr R. C. Chatterjee, *Associate*, has been appointed senior development chemist to D. Waldie & Co. Ltd, Konnagar, West Bengal. He was formerly chief chemist, Albert David Ltd, Calcutta.

Dr J. W. Cook, F.R.S., *Past President*, vice-chancellor of the University of Exeter, has been appointed a member of the Council for Scientific and Industrial Research.

Dr C. V. Cutting, *Fellow*, has been promoted to the newly-created post of senior specialist officer in the Department of Agriculture, Limbe, Nyasaland, with the grade of senior agricultural chemist.

Mr H. M. Diack, *Associate*, formerly with Burmah Shell Refineries Ltd, is now with the Shell Refining Co. Ltd, Shell Haven.

Dr I. J. Faulkner, *Fellow*, ammonia works manager of Imperial Chemical Industries Ltd, Billingham Division, is to attend the annual meeting of the Ceylon Association for the Advancement of Science as an official delegate of the British Association. He will leave this country on 20 November, and after 14 days in Ceylon will visit India for technical talks.

Mr M. L. Hair, *Associate*, has returned to this country to take up an appointment with Imperial Chemical Industries Ltd, Billingham Division. He formerly held a fellowship in the division of applied chemistry, National Research Council, Canada.

Mr A. Hayward, *Associate*, formerly employed in the research department of the Distillers Co. Ltd, is now with the engineering department of Borax Consolidated Ltd.

Dr W. B. Jepson, *Associate*, has joined the Metallurgy Division, Atomic Energy Research Establishment, Harwell. He was formerly at the Washington-Singer Laboratories, University of Exeter.

Mr W. C. Johnson, M.B.E., *Fellow*, technical director of Hopkin & Williams Ltd, has recently returned from a lecture tour in which he visited Uganda, Tanganyika, Northern and Southern Rhodesia and South Africa.

Dr F. H. Kendall, *Fellow*, lecturer in radiochemistry, Sir John Cass College, has left this country for one year to take up an appointment as adviser on radiochemistry to the Government of Ceylon under the Technical Assistance Scheme of the International Atomic Energy Agency.

Mr W. G. B. Mills, *Fellow*, has been appointed technical director on the board of the Dohn group of companies.

Dr J. W. W. Morgan, *Associate*, has taken up an appointment at the Forest Products Research Laboratory, Princes Risborough. He was formerly with British Celanese Ltd.

Mr L. W. Rodway, *Fellow*, has been appointed manager of market research and development, B.T.R. Industries Ltd.

Mr J. Rudkin, *Associate*, is now a project engineer with John & E. Sturge Ltd, Birmingham.

Mr D. Shuttleworth, *Fellow*, formerly of the chemical division of the Distillers Co. Ltd, Hull, has joined Maconochie Bros Ltd as technical manager.

Mr R. S. Silman, *Fellow*, has resigned as managing director of Nuclear Graphite Ltd, and is now managing director of the Ship Carbon Co. of Gt Britain Ltd, a subsidiary of the Morgan Crucible Co. Ltd.

Mr E. A. Simmons, *Associate*, is now with the West African Stored Products Research Unit, Port Harcourt, Nigeria.

Mr V. W. Slater, *Fellow*, director and chief chemist of Laporte Industries Ltd, received a presentation to commemorate 40 years of service at a recent meeting of the company's '25-year club.'

Sir William Slater, K.B.E., F.R.S., *Fellow*, until recently secretary of the Agricultural Research Council, has been appointed chairman of the governing body of the Glasshouse Crops Research Institute.

Dr L. E. Smythe, *Associate*, senior principal research officer, Australian Atomic Energy Commission Research Establishment, is at present on a two months' visit to atomic energy research centres in the U.S.A., Canada and the U.K. He left Australia early in October.

Dr W. Stein, *Fellow*, has been appointed chief chemist, Joseph Lucas (Electrical) Ltd, Birmingham.

Dr C. T. H. Stoddart, *Associate*, is now with the Autonomics Division, National Physical Laboratory, Teddington, having returned to this country from the Johns Hopkins University, Baltimore.

Professor E. E. Turner, F.R.S., *Fellow*, formerly of Bedford College, University of London, has taken up a

post with Biorex Laboratories Ltd as director of research at the company's new research laboratory to be opened shortly in City Road, London, E.C.1.

Dr R. F. J. Weil, *Associate*, has left the English Electric Co. Ltd to take up an appointment as research director at the Passfield Research Laboratories of Metal Containers Ltd.

Distillers Co. Ltd.—Dr H. M. Stanley, *Fellow*, has been appointed controller of a new development division in the Industrial Group, formed to direct and coordinate the company's research, planning and licensing, particularly in the fields of chemicals and plastics; he will work from 21 St James's Square, London, S.W.1. Mr C. E. Hollis, *Fellow*, has been appointed manager of the central research department, Great Burgh, Epsom; Mr G. P. Armstrong, *Associate*, manager, licensing department; and Dr H. W. Ashton, *Associate*, manager, planning department.

FORTY-THIRD CONFERENCE OF LOCAL SECTION HON. SECRETARIES

The Forty-third Conference was held in the Council Room, Royal Institute of Chemistry, London, at 10 a.m. on Saturday, 22 October, the Chair being taken by the President, Mr E. LeQ. Herbert. Professor Harold Burton (Hon. Treasurer; Chairman of the Finance and House and Benevolent Fund Committees), Mr E. J. Vaughan (Chairman of the Membership Committee and of the Study Group on Qualifications), Dr G. R. Ramage (Chairman of the Institutions Committee) and Dr F. A. Robinson (Chairman of the Professional Status Committee) were present, and the Administrative Officers were in attendance. The Local Sections were represented by their Hon. Secretaries, except for Cardiff and District (Mr H. K. B. Rout, Chairman, in place of Mr R. C. F. Stephens), Glasgow and West of Scotland (Dr W. D. Williams, Hon. Assistant Secretary, in place of Dr W. Gibb), and Leeds Area Section (Mr R. K. K. Fourness in place of Mr W. A. Wightman).

The Cumberland and District and the Dundee and District Sections were unable to send representatives.

Armorial Bearings. Advantage was taken of the opportunity to distribute line blocks of the Institute's Armorial Bearings for use on dinner menu cards, invitation cards and the like, suitable for printing on paper or thin pasteboard. In this way a uniformly high standard of reproduction will be achieved.

Attendance at Section Meetings. Mention was again made of the difficulty smaller Sections, particularly those whose membership was dispersed in a number of widely separated centres, had in ensuring good attendances at meetings. Judged on the basis of the percentage of the total membership, attendances in such areas could be regarded as reasonably satisfactory. However, to provide audiences that justified securing distinguished lecturers, it was to be expected that joint meetings with other societies would be necessary. It was thought desirable that invitations should be widely extended to individuals and societies and that the interest of the meetings would be enhanced by providing opportunities for social activities.

As a major purpose of Local Sections was to foster a corporate spirit, lectures need not be highly specialized. Lectures with a wide and popular appeal, sometimes associated with a ladies' evening or other social occasion, and events containing a spice of entertainment, were often rewarding features in the calendar. Meetings with members of other professions on matters of common interest could also be of considerable value.

Notices and Posters. The routine arrangements for the printing of Section notices and posters were outlined for the benefit of new Local Section Secretaries, who in turn made a number of useful suggestions for their improvement. It was agreed that these would be examined and, if practicable, would be adopted.

H.N.C. in Biochemistry. The question as to whether it would be desirable to introduce a Higher National Certificate in Biochemistry was raised by the Aberdeen and North of Scotland Section. It appeared that at present the only two examinations with which work of a suitable standard could be incorporated were those for the A.I.M.L.T. and the H.N.C. in Applied Chemistry. Nothing else below the standard of a university degree appeared to exist, although a H.N.C. in Biology had been proposed.

After discussion, it appeared to be the view of the meeting that the most suitable way of dealing with this difficulty would be the inclusion of biochemistry in schemes for the H.N.C. in Applied Chemistry or as an endorsement subject on a H.N.C. in Chemistry. This would ensure that the student had an adequate background of chemistry, particularly organic and physical chemistry.

Publication of Examination Results. A question was raised by the Hull and District Section about the time that elapsed before the publication of the results of examinations with which the Institute was concerned, especially those for National Certificates. Satisfaction was expressed with the information furnished by the Officers on arrangements made to avoid undue delays in issuing pass lists.

Grad. R.I.C. and Dip. Tech. Courses. It had been questioned whether the introduction of sandwich courses for the Diploma in Technology did not constitute a threat to the Institute. There might have been some substance in this suggestion if the Institute had not taken steps (i) to encourage the introduction of sandwich courses leading to the Grad.R.I.C. and (ii) to accept 1st or 2nd class honours gained in certain Dip. Tech.

examinations in Applied Chemistry as exempting from the Grad.R.I.C. examination. From the Institute's point of view, the most important aspect was to see that conditions for advanced students were improved, by the provision of sandwich courses or, for part-time students, by introducing a period of full-time study during the final year.

Possible New Grade of Membership. The Conference discussed in some detail the outline of tentative proposals published in April last (*J.*, 122), to which attention had been drawn at the previous Conference (*J.*, 184). Since that time many meetings of Local Sections and their Committees had been held to discuss the proposals. It now appears that there is evidence of widespread support, in principle, for the establishment of a new grade of membership at what may be described as a good 'pass' degree level, provided that this would in no way conflict with the interests of members of existing grades. On the other hand, there has been very little support for the formation of an affiliated group of Registered Chemical Assistants or the like.

The general character of the Council's suggested provisions for a Licentiateship grade appears to have met with widespread acceptance. Further attention is therefore being given by the Study Group on Qualifications to clarifying the principles involved and working out essential details (*see* also the note on p. 398).

The Conference welcomed the progress that had been made so far and recommended to the Council that the enquiry be pursued with a view to putting the proposals into a form in which their merits could be more fully assessed.

In further amplification of the proposals, it was emphasized that the equivalent of a good 'pass' degree was thought to be desirable as the academic standard of the Licentiateship, for such a degree was already accepted by government and industry as conferring the right to the title of qualified scientist. In addition it would seem appropriate to require a period of approved experience before admission to Licentiateship, for this would be a 'permanent' grade, as distinct from the present 'transitional' grades of Student and Graduate Membership.

In conclusion, the Officers and Chairmen of Committees, on behalf of the Council, recorded their appreciation of the work done by the Local Sections in examining these proposals and in making a prior assessment of the views of the membership on this peculiarly difficult problem.

Recent Publications. The Conference received a report on current publications projects, including those sponsored by the Educational Trust Fund. The success of the first three 'Monographs for Teachers' had encouraged the Council to press forward with this series; four new titles were in course of preparation, and a further four topics had been selected.

A new edition of the *Index of Chemistry Films* was in the Printer's hands, and it was scheduled for publication in January, 1961. Considerable additions to entries for both films and filmstrips were being made, and dates of production were being included where known.

Three filmstrips were now available in the R.I.C. Series obtainable from the Educational Supply Association, and others were in course of preparation.

The 'Training Guide' recently announced (*J.*, 368) had been widely welcomed, and it was hoped to produce a printed version in due course.

The first of a series of special-purpose books being planned by the Publications Committee was also available—the *Laboratory Handbook of Toxic Agents* (*J.*, 367). The principle had now been established that full discount (25 per cent) would be allowed to members purchasing single copies of any book published by the Institute and on general sale through trade channels. (This does not apply to any of the present paper-bound publications which are mainly purchased direct from the Institute and for that reason are already priced as low as possible.)

Service to Educational Establishments. Attention was drawn to the survey (*J.*, 368-9) of the extent to which chemists are assisting in the governance of educational establishments. It was known that the returns were incomplete, but even so it was clear that the widest representation is to be found on the advisory committees of technical colleges, whereas the number of members serving on the governing bodies of schools was smaller than expected.

This matter had been raised at an earlier Conference (*J.*, 1958, 727), for it appeared that in several areas little use was being made of chemists' services, though it was known that many were willing to fill vacancies that occurred on Governing Bodies.

The Conference was pleased to learn that already, as the result of publication of the survey, some members were known to have been invited to serve on local governing bodies.

Commonwealth Technical Training Week. The attention of Hon. Secretaries was drawn to the first Commonwealth Technical Training Week being organized under the patronage of H.R.H. the Duke of Edinburgh during the period 29 May–4 June, 1961. Events were being arranged locally throughout the country and it was hoped that Local Sections would be associated with any suitable events, such as careers talks and exhibitions, that are taking place in their areas.

At the conclusion of business, Mr Herbert indicated that this would be the last occasion on which he would occupy the Chair as President, and Mr R. Shackleton (Manchester and District) expressed the thanks of the Hon. Secretaries for the helpful manner in which this and past meetings had been conducted.

Section Activities

BELFAST AND DISTRICT

Syndets and Sewage Disposal. On 7 October, the first meeting of the session was held in the Chemistry Lecture Theatre, Queen's University, Belfast, when the Chairman of the Section, Professor C. Kemball, presided. A paper entitled 'The Effects of Synthetic Detergents on the Public Health Services' was read by Dr B. A. Southgate, C.B.E., director of the Water Pollution Research Laboratory, D.S.I.R.

Dr Southgate began by referring to pre-detergent problems of sewage and industrial-waste disposal, stressing the reasons why pollution of rivers, and so on, could not be tolerated. In describing modern sewage-disposal works, he pointed out that the efficiency of the process depended on the absence of materials which would inhibit bacterial activity and transfer of oxygen from gas to liquid phase. Ordinary soaps were never a problem in any of these respects because they were oxidized by bacterial action and disappeared during sewage treatment. The surface-active agents in detergents, on the other hand, were exceedingly troublesome. Foaming was an obvious and much-advertised nuisance but this could be cured by expensive procedures such as spraying high-pressure water on the effluent, or by the use of defoamants. Less obvious, but more serious, was the decided interference with the efficiency of sewage treatment and with the reoxygenation of the rivers.

Since redesign of sewage works was out of the question, research into the production of a 'biologically soft' surface-active agent was instituted. Such an agent would be destroyed during sewage treatment. In 1958 tests were begun on a detergent claimed to have this desirable property, and Dr Southgate concluded his remarks by describing these tests and their reasonably successful outcome.

A vote of thanks was proposed by Dr A. J. Howard.

EAST ANGLIA

The first meeting of the Winter Session was held on 28 September at Manningtree, by kind permission of B.X. Plastics Ltd. A lecture was given by Dr A. T. James of the National Institute for Medical Research, Mill Hill, entitled 'Gas–Liquid Chromatography.' The speaker gave a very concise account of the development of the technique and illustrated the wide range of application by reference to examples in which it has already been employed. Dr F. C. Lloyd was in the Chair and a vote of thanks was expressed by Dr Smith.

Annual General Meeting. The Annual Meeting was held on 14 October. This was the first occasion at which members were able to enjoy the facilities provided at the recently erected Civic College at Ipswich. The Section was pleased to welcome Mr F. C. Hymas, the District Member of Council, and Mr D. A. Arnold, Assistant Secretary (Administrative) of the Institute.

The Officers elected were Mr H. F. Bamford as Chairman, Mr R. J. Nunn as Hon. Secretary and Dr F. C. Lloyd as Hon. Treasurer. Thanks were expressed to Dr E. C. Wood, the retiring Chairman, and to Mr H. F. Bamford, for his services as Hon. Secretary for a period of seven years.

A very lively discussion was held on the proposed new grade of membership. It emerged that a very wide difference of opinion existed amongst the members present.

Mr Arnold gave a very informative talk entitled 'In the Public Interest' in which he outlined some of the functions and charter obligations of the Institute and the services which are available to the members. A vote of thanks was given by Mr H. F. Bamford.

HUDDERSFIELD

North Eastern Forensic Science Laboratory. On 29 September a party of members visited the North Eastern Forensic Science Laboratory at Harrogate. Dr I. M. Barclay, the director, first outlined the work of the laboratory, as one of the seven regional laboratories under the F.2 division of the Home Office. The Harrogate laboratory serves the three Ridings of Yorkshire, with their numerous cities and boroughs, including 16 police forces and $4\frac{3}{4}$ m. people. He distinguished the two sides of forensic work—scientific investigation and presentation of evidence. As an example he considered the scientific and legal aspects of blood and urine alcohol contents, a subject of great interest to all road-users.

Mr S. S. Kind described the biological section's work, which consists of the identification of a wide variety of materials of biological origin. He demonstrated the benzidine test for blood, using a murder weapon of 20 years ago, which, although it bears no visible evidence, continues to give a positive result to a test for blood. The precipitin test for determining the species from which the blood came, and the use of the acid-phosphatase test for seminal stains, were also demonstrated. As in other parts of the laboratory, a large number of exhibits were laid out to illustrate the identification of woods, blood groups and natural and man-made fibres.

The work of the physical examinations section was described by Mr H. Powell. The use of 'physical fit' methods to match fragments associated with a crime and a suspect was demonstrated, this being particularly useful in connection with road accidents and burglary. The visitors also saw the identification of soils by differential thermal analysis, the detection of forged coins and methods used in cases of safe-blowing.

Dr A. S. Curry described the work of the chemical section, which covers a wide range of activities. Many children die from the accidental taking of drugs, and

the danger from highly toxic 'domestic' products in the home was well demonstrated. Work in connection with abortion, the identification of carbon monoxide in air and blood samples, and the analysis of drugs by paper chromatography were all described.

The visit to this laboratory was a memorable occasion and Dr E. Tittensor, the Section Chairman, expressed the thanks of the party to Dr Barclay and his staff.

New Grade of Membership. A meeting was held in the Alexandra Chambers, John William Street, Huddersfield, on 20 September, to discuss the Council's statement on a possible new grade of membership (*J.*, 122). The Chair was taken by Dr E. Tittensor. Dr G. R. Ramage, a Vice-President of the Institute, and Dr R. L. Elliott, District Member of Council, attended the meeting in order to explain the Council's views on the matter.

At the outset Mr W. S. Mitchell proposed and Mr W. R. Barker seconded a formal motion 'that The Royal Institute of Chemistry should establish the Licentiate grade of membership.' Dr Ramage opened the discussion by outlining the very great difficulties experienced by students who obtain professional qualifications by part-time studies. For one reason or another, many do not attain the full qualifications, and yet they have made considerable endeavours and are doing very important work in industry. It was considered that some recognition of this should be given by the Institute. The meeting was in general agreement with this point of view and later voted unanimously in favour of the establishment of the Licentiate grade.

There was some discussion also of the Part II Grad. R.I.C. examination, since it was considered that the course work for the examinations often bore little or no relationship to the subject matter of a student's daily work. Some members thought that provision should be made for a student to offer himself for examination in Part II in specialized branches of the chemical industry, particularly those related to local industries.

A discussion of the proposed Register of Chemical Assistants followed. It was thought that there was little point in such registration since the technical colleges and the Institute already had a register of those who had H.N.C. in chemistry. Nevertheless, it was strongly felt that both the Institute and former students lost something when people who had been associated as Student Members for several years ceased to have contact with the Institute. Some of those present were of the opinion that registration as 'Chemical Assistants' would give a derogatory title to the persons concerned, implying less than their true ability. It was considered, however, that the Institute should maintain some form of register, and that those so registered should have a grade of membership. On voting, it was unanimously agreed that holders of the H.N.C. in chemistry or applied chemistry should be allowed to become 'Members' of the Instiutte. This general membership should be open to those who could not gain admission to a grade conferring the right to use designatory letters.

HULL AND DISTRICT

Scientific Film Evening. On 28 September the first meeting of the Winter Session was held at the Francis Reckitt Institute, Hull. This took the form of a Film Show to which senior pupils from local schools were specially invited.

The following films were shown: Radioisotopes in Industry (U.K. Atomic Energy Authority); The Chemistry of Aluminium (Aluminium Development Association); Antibiotics and Terramycin (Pfizer Ltd); The Chemistry of Oil (Petroleum Films Bureau); A Study in Black (Cabot Carbon Ltd).

Thanks were expressed to Messrs Reckitt & Sons Limited, who kindly allowed the use of their facilities.

Marfleet Refining Company. A party of members and guests visited the factory of the Marfleet Refining Company, Hedon Road, Hull, on Saturday morning, 10 September. They were received by Mr S. A. Reed and other members of the staff and given a survey of the activities of the Company before touring the works, which produces various grades of cod liver oil.

The work begins at sea aboard the trawlers, where the livers taken from the fresh fish are boiled and the oil stored in special tanks. On arriving at Hull and Grimsby, the oil is transferred to dockside factories for preliminary refining. The semi-crude product, after grading, is transferred to the Hedon Road refinery for

further refining, deodorizing, cold clearing and blending into grades as required. A close check on the vitamin A content and the general quality of the oil is kept during the processing. The former is effected by a spectrophotometric method, whilst Vitamin D is assessed by biological assay on rats.

In the tank room large quantities of oil are stored for blending so as to maintain uniform vitamin levels. The potency of crude oils is higher in summer than in winter, and hence some balance of stocks is necessary. Stearin

materials are removed by refrigeration and impurities, such as aldehydes and ketones, are removed by high-vacuum steam distillation. The products are graded into medicinal qualities for human consumption, veterinary oils for animal feeding and technical oils for tanning and leather dressing. Certain qualities of oil are hardened and, after special refining and processing, used in compound cooking fats.

The tour concluded with a visit to the chemical laboratories where the analytical methods used were explained.

The party was then entertained to morning coffee, during which there was an opportunity for further discussion. Mr L. Malin thanked the hosts on behalf of the Section for an interesting and instructive visit.

LONDON

B.B.C. Television Centre. On 14 July, members visited the B.B.C. Television Centre at Wood Lane, London, and were taken on an interesting tour of the new building. A comprehensive description of the future stages of the development programme left members with a keen desire to make a second visit when the Centre is finally complete.

Mr A. C. L. Bennett, senior assistant, television liaison section, explained that for the first time a building had been *designed* rather than converted for television. In deciding on a circular plan the architects had solved the previous difficulties of opposing movements of scenery, services and personnel. In the present design all dressing rooms, assembly areas, buffets and so on are located in an inner ring on the ground floor, the studios being arranged around this in a wider concentric ring, and the whole being encircled by a wide tunnel-roadway through which scenery and services from adjacent buildings can pass into the studios. The higher floors of the building are devoted almost entirely to administrative offices.

One studio, T.C.3, which was the first to be completed and had been opened only nine days previously, was viewed from behind the producer's control room and also from the floor. Its 8,000 sq. ft were occupied by artists and technicians rehearsing for the programme 'Quicker by Tube.' Altogether seven studios are planned, the largest (11,000 sq. ft) of which will be ready by 1962.

Members also toured scenery workshops and stores, the property stores, dressing and conference rooms and restaurants; the whole of the present site can be seen fom the roof of the building, which towers over neighbouring Shepherds Bush and the White City, and its future development visualized. The extensive panoramic view of London included the B.B.C. transmitter at the Crystal Palace.

The visit concluded with a short call at the Television Theatre (the old Shepherds Bush Empire) to see the final minutes of camera rehearsals for 'Al Koran.'

On behalf of the members, Mr P. F. Corbett, Hon. Treasurer of the Section, thanked Mr Bennett for his detailed explanations, and wished the Corporation every success in the next stages of its progressive and planned development. He said that the members felt particularly honoured to have visited the Centre so soon after its official opening, and all had profited from and enjoyed the experience.

Film Show. On 6 October, a film show was held at Croydon Technical College. Dr S. R. Robinson, head of the science department, welcomed the audience, and introduced Mr F. C. Hymas, Chairman of the Section.

Mr Hymas congratulated the college on its new building, just completed, especially the spendid Denning Hall, in which the meeting was held. He then called upon Dr J. H. Pryor to present the films: 'Principles of Chromatography'; 'A Vitamin Emerges'; 'Beauty in Trust'; 'Packaged Power'; and 'Refinery at Work.'

The Chairman expressed the thanks of the meeting to the Governors and Principal for the use of the hall, and said he hoped there would be many similar meetings in the future.

Second Humphry Davy Lecture. The President took the Chair for this meeting, held on 12 October at the Royal Institution. In introducing the speaker, Professor V. N. Kondratiev, the President gave a brief account of his achievements, expressing the Institute's pleasure at having so distinguished a visitor. The lecture, 'Energy Exchange in the Interaction of Particles under Electric Discharge,' will shortly be printed in the *Lectures, Monographs and Reports* series (*see* p. 401).

MID-SOUTHERN COUNTIES

Chemical Binding and Molecular Architecture. On 14 October, Professor R. S. Nyholm, F.R.S., lectured at Taunton's School, Southampton, on 'Chemical Binding and Molecular Architecture.' This lecture was the first that has been arranged particularly for sixth form students and was held jointly with the Science Masters' Association. It was part of the Bicentenary Celebrations of Taunton's School, which was founded in 1760 for the 'employment and maintenance of poor people, at my Dear Town of Southampton and bringing up their children in work and industry, fitting them for the sea.' Taunton's School, whose emphasis on navigation lent itself to a liberal scientific education, is today known for its scientific achievements, as was shown by the new science wing that was opened recently by Lord Louis Mountbatten.

The meeting was presided over by the President, Mr E. Le Q. Herbert, and the Royal Institute of Chemistry was also represented by Professor H. Burton, Honorary Treasurer, Dr H. J. T. Ellingham, Secretary and Registrar, and officers of the Mid-Southern Counties Section.

In his introductory remarks Professor Nyholm stressed that chemistry is still an experimental science, this being emphasized by the use of demonstration experiments, including the classical bubble experiment to show that when hydrogen and oxygen combine energy is released. He proceeded to show that inorganic chemistry is no longer the study of 'dry bones'; it now has shape and system. Crystal structure was illustrated by both static and working models and several slides were shown, including the following chart.

SYSTEMATIC STUDY OF INORGANIC CHEMISTRY

1. Preparation or where found
2. Composition — Qualitative analysis; Quantitative analysis

In the 'dry-bones' era inorganic chemistry ended here

3. Structure
   - Type — Ionic; Covalent — Complex Ion; Molecule; Giant Lattice
   - Co-ordinate number
   - Stereochemistry
   - Nature of bond, Quantum numbers, Bond orders, Theory of Valency and Inter-relations
4. Thermodynamic Studies — Equilibrium; Heat of reaction

Finally, via electron orbitals, ionization potentials and a short discourse on energy, the molecular architecture was exposed to full view.

Mr H. Lockett, Senior Science Master of Taunton's School, proposed the vote of thanks and included in it thanks to the Royal Institution for the models and to their demonstrator, Mr Coates.

NEWCASTLE UPON TYNE AND NORTH-EAST COAST

Summer Outing. On 29 May, a party of members, with their families and friends, visited the Farne Islands off the coast of Northumberland. The perfect weather enhanced the pleasure of a short sea trip and a picnic on the islands, and also enabled the visitors to watch the seals at close quarters.

Special General Meeting. A Special General Meeting was held on 11 October in the Chemistry Building, King's College, to discuss the Council's proposals for a possible new grade of membership and category of affiliation. Before opening the discussion, the Chairman, Dr K. H. Jack, paid a short tribute to the late Mr W. Marsden, who had been Hon. Treasurer for the past 13 years. Until an election can take place, the Treasurer's duties have been taken over by Mr L. H. W. Hallett.

Dr Jack then gave a *résumé* of the events leading to the Council's present proposals. Mr C. C. Skou, District Member of Council, then put forward the Council's views on the creation of the Licentiate grade of membership and a Registered Chemical Assistants Group affiliated to the Institute, stressing that policy would only be decided after members had been given ample opportunity to make their views known. Personally, he thought that the Institute should increase its control over the education and standards of education of a much larger number of chemists by creating the new grade.

By contrast, Dr J. O. Harris considered that the Institute should have two grades of membership, Fellowship and Associateship, and should widen its scope by admitting holders of university pass degrees to the Associateship. He thought that H.N.C. plus the further training required for the proposed L.R.I.C. represented a rather nebulous standard, in contrast with the well-established standards of the university pass degree. He was supported by Dr G. E. Stephenson, who thought that the standard of the present Grad.R.I.C. examinations was far above that of qualifying examinations of other comparable Institutes. Several later speakers, including Mr L. H. W. Hallett and Dr J. R. Gwilt, considered that the standard of the Grad.R.I.C. was too high, leading many students to take other examinations such as those of the Institute of Fuel, which they regarded as professional qualifications. The lack of uniformity in H.N.C. standards throughout the country was also stressed. Part I of the Grad.R.I.C. examination was thought to be too high for the proposed L.R.I.C. Two other speakers, Mr D. L. Ward and Mr J. K. Blacklock, emphasized the need for some qualification below Grad.R.I.C. but considered that the Grad.R.I.C. should remain at its present high standard. Finally, Dr J. Gibson pointed out that the immediate issue was not one of standards but rather whether there was a need in principle for a new grade of membership.

The meeting then resolved that 'Provided suitable standards are maintained, this Section is in favour of establishing a Licentiate grade of membership of the Institute.'

A resolution approving the formation of a Registered Chemical Assistants Group affiliated to the Institute gained no support.

'The Times': Reduced Rate for Students.—Students at university, technical college and school are reminded that they can obtain *The Times* at the reduced rate of 2½*d.* a copy. Registration forms and full particulars can be obtained from The Subscription Manager, *The Times*, Printing House Square, London, E.C.4.

Library of the Chemical Society.—The Library will close at 1 p.m. on Friday, 23 December, and will reopen at 9.30 a.m. on Thursday, 29 December.

News and Notes

MEETINGS AND CONFERENCES

Institute of Physics.—The London and Home Counties Branch of the Institute of Physics and the Physical Society is holding an all-day symposium on 'New Materials of Interest to the Physicist' on 25 November at the Institute of Electrical Engineers, London. Topics include new optical and plastic materials, recent advances in alloys and adhesives, high purity metals and modern magnetic materials. Further details and application forms may be obtained from the Secretary, 47 Belgrave Square, London, S.W.1.

Iron and Steel Institute.—The Autumn General Meeting will be held on 29–30 November. The technical sessions will include two symposia, 'Fluid Flow in Furnaces and Converters' and 'Martensite,' which will run concurrently. On the evening of 29 November, Mr L. Rotherham, member for research, C.E.G.B., will deliver the 13th Hatfield Memorial Lecture. His subject will be 'The Contribution of Metallurgy to Electric Power Generation.' Non-members will be welcome to attend this lecture, and a symposium on 'Steels for Reactor Pressure Circuits' which will be held on 30 November to 2 December. All these functions will take place at Church House, Great Smith Street, London, S.W.1. Further information and tickets for admission may be obtained from the Secretary, 4 Grosvenor Gardens, London, S.W.1.

Ninth National Plastics Exposition.—The Exposition will take place at the New York Coliseum on 5–9 June, 1961. The growth of the industry, the development of new materials, methods and machinery will all be demonstrated at the Exposition, which is to be held concurrently with the Ninth National Plastics Conference at the Commodore Hotel, New York.

Ninth SIMA Convention.—Faced with the consequences of European free trade and the reduction of protective tariffs, the Scientific Instrument Manufacturers Association has decided that 'Productivity' will be the main theme of its Ninth Convention. The Convention will take place at Eastbourne on 17–20 November. Four panels of highly-qualified speakers will deal with the most important aspects of productivity as it affects the industry. The fields to be covered are design, management, floor production and sales. Further information may be obtained from the headquarters of the Association, 20 Queen Anne Street, London, W.1.

Nuclear Events in San Francisco.—The Atomic Industrial Forum and the American Nuclear Society are co-sponsoring the first nuclear industry exhibition in Western America. AtomFair-West will be held on 12–15 December at the Masonic Memorial Building, in conjunction with the 1960 Winter Meeting of the American Nuclear Society (12–15 December) and the 1960 Annual Conference of the Atomic Industrial Forum (14–16 December), the theme of which is 'Nuclear Frontiers—a challenge to industry.' Further details may be obtained from the Atomic Industrial Forum, 3 East 54th Street, New York 22, and the American Nuclear Society, 86 East Randolph Street, Chicago 1.

Plastics Institute.—A symposium on plastics and corrosion is to be held at 2.15 p.m. on 29 November, the opening day of the Corrosion and Metal Finishing Exhibition, at the Empire Restaurant Hall, Olympia, London. Subjects include engineering applications of protective packaging, plastics as heavy protective coatings, and the role of fabricated plastics in combating corrosion. Free tickets of admission may be obtained from the Secretary of the Plastics Institute, 6 Mandeville Place, London, W.1.

Rhodesia and Nyasaland Symposia.—The fifth symposium in the series organized by the Department of Chemistry, University College of Rhodesia and Nyasaland, will be held on 25 November, when Dr H. Weinmann, Chief Agricultural Chemist, Federal Ministry of Agriculture, will speak on 'Carbohydrate Analysis.'

Symposium on Inorganic Polymers.—An International Symposium on Inorganic Polymers, sponsored by the Chemical Society, will be held at the University of Nottingham on 18–21 July, 1961. It will consist of main lectures and contributed papers, and the opening address will be given by Dr J. S. Anderson, F.R.S. English, American and German speakers have agreed to give main lectures, and it is hoped that a speaker from the U.S.S.R. will also attend. Those wishing to present papers should submit the title and a summary of about 250 words not later than 1 January, 1961, to the Secretary, International Symposium on Inorganic Polymers, Department of Chemistry, University of Nottingham. Each speaker will be allowed 15 minutes to present his paper, and there will be time for discussion. The full programme and application forms will be available in March, 1961, from the General Secretary, the Chemical Society, Burlington House, London, W.1.

UCL Public Lectures.—The programme of public lectures arranged for the autumn term at University College, London, includes three talks on 'The History of the Petroleum Industry' by Professor R. J. Forbes, at 5.30 p.m. on 16–18 November in the Chemistry Theatre; 'Ubiquinones and Related Substances: Nature and Biological Functions,' two lectures by Professor R. A. Morton, on 17 and 24 November at 5 p.m. in the Physiology Theatre; and 'The Social Function of

Science—1960' (The Rickman Godlee Lecture) by Professor Sir Solly Zuckerman, on 8 December at 5.30 p.m. in the Anatomy Theatre.

RECENT PUBLICATIONS

A.B.C.M. Careers Booklet.—A new careers booklet entitled 'The Chemical Industry—A Career For You' has recently been published by the Association of British Chemical Manufacturers. A useful appendix gives details of opportunities for training and careers in various firms. This booklet is designed to attract young people leaving school, technical college or university to invest their future in the chemical industry.

Copies of the booklet have been circulated to Youth Employment Offices, University Appointments Boards and careers teachers in schools. Free copies are available from A.B.C.M., 86 Strand, London, W.C.2, for *bona fide* inquirers interested in pursuing a career in the chemical industry.

Advisory Council on Scientific Policy.—In its Report for 1959–60 the Advisory Council claims that the development of colleges of advanced technology and the expansion of the smaller universities will provide an opportunity to promote studies in fields where there is little or no tradition of research and its application. In this connection the possibility of greater co-operation between the universities and colleges of advanced technology in the use of available facilities should be seriously examined.

Another important section in the Report considers 'Education in Science.' In this section the Advisory Council has examined the implications for scientific education of the Crowther Report. The Council is in no doubt that school science curricula are in need of a thorough re-examination, and it is suggested that up to 20 or 25 per cent of the content of the curricula in physics, chemistry and biology could be removed without any harm. The Council also gives the opinion that specialization in schools has gone too far. Many universities, the Report says, would welcome a lower level of factual knowledge from sixth-formers, provided this is combined with a broader general education. A major extension of part-time education to the age of eighteen and the extension of sandwich courses are thought to be of greater urgency than the raising of the school-leaving age.

Analytical Biochemistry.—The appearance of any new journal must be regarded with mixed feelings. To justify its inception it must either deal with some new subject or, as one may hope that this new publication will do, gather within its covers papers which would otherwise be scattered among several other journals. The subject of *Analytical Biochemistry*, a new international journal, however, is still wide enough for readers to find only a proportion, even a minority, of its articles of direct value.

The first issue (Academic Press, June, 1960, $15 for six issues) contains nine ordinary papers and three short communications. One article on the chemical synthesis of β-keto-octanoyl coenzyme A might appear out of place, but the journal's stated purpose is to publish contributions on analytical and preparative procedures. The inclusion of short publications is welcome; useful minor analytical modifications can be published in a short space without inflating them into full-length papers. Articles dealing with the chromatography of human serum lipoproteins, the radio-assay of aqueous solutions, and the determination of potassium, sodium and chloride in microlitre quantities of fluid are included, while another describes a fractionating column for the analysis of nucleic acids. The journal could well come to serve a useful purpose in its field.

H. Varley

Gmelins Handbuch.—Three new items in the series have been announced.

System No. 3. Oxygen, Section 4 (Wrappers, DM233).
System No. 29. Strontium, Supplement Volume. (Cloth, DM200).
System No. 30. Barium, Supplement Volume. (Cloth, DM359).

These contain German and English indexes and English headings and sub-headings in the margins. They are obtainable from Verlag Chemie, GmbH, Weinheim/Bergstr., Germany.

Heat Exchangers.—*Wärmeaustauscher*, a Dechema book on heat exchangers which has been out of print for some time, has now been reprinted in an enlarged and revised form and can be obtained from Dechema, Frankfurt (Main) 7, Germany, at DM 43.60 post free.

International Conference on Scientific Information.—The Proceedings of the International Conference on Scientific Information held in November, 1958, have now been published in two volumes. The Proceedings may be obtained on application to the Printing and Publishing Office, National Academy of Science–National Research Council, 2101 Constitution Avenue, Washington 25, D.C., U.S.A., at $20 (£8) per two-volume set.

Russian Chemical Reviews.—The Chemical Society, in conjunction with the D.S.I.R., has undertaken the first English translation of the leading Russian Chemical Review Journal, *Upsekhi Khimii*. It is to be issued in monthly parts, which correspond to the original, with omission only of articles translated from foreign periodicals. The first number contains four articles: 'The chemical action of ultrasonic waves on macromolecules' by I. E. El'Piner; 'Developments in the

chlorination of saturated hydrocarbons' by Z. S. Smolyan, P. S. Pyryalova, and N. A. Kurdyumova; 'The hydrides of the rare-earth metals' by V. I. Mikheeva and M. E. Kost; 'The chemistry of quinuclidine derivatives' by M. V. Rubtsov, E. E. Mikhlina, and L. N. Yakhontov. Each review contains 100–200 references, about one-third of which are to Russian periodicals, some of them relatively obscure ones.

The standard of the reviews is high, with perhaps a rather more empirical and applied basis than similar ones in Western journals. This undertaking is undoubtedly an important contribution to broadening the basis of contacts with Russian chemistry, and the reviews are useful by any standards. The price is surprisingly low (£9 to universities and technical institutions, £12 to other users), and the standard of general production and formula reproduction and translation is high. A. J. BIRCH

Russian Journal of Physical Chemistry.—The Chemical Society has now produced the first cover-to-cover translation of *Zhurnal Fizicheskoi Khimii* (Russian Journal of Physical Chemistry) starting with the July, 1959 issue.

Orders should be sent to Cleaver-Hume Press Ltd. 31 Wright's Lane, London, W.8. The ordinary subscription rate is £30 per annum (£45 for the first 18 issues) with a reduction of 25 per cent to colleges and universities.

Chemical Institute of Canada.—Professor R. B. Sandin, Professor of Chemistry at the University of Alberta, was recently presented with a special scroll in recognition of his contributions to research and the teaching of chemistry. Professor Sandin has been most successful in inspiring young chemists; it is noteworthy that of the six winners of the Merck Award of the C.I.C. (presented to outstanding young chemists in the field of organic chemistry or biochemistry) three have been his students. The presentation took place during the Fourth Biennial National Symposium of the Organic Chemistry Division of the C.I.C., held on 6–7 September at the University of Alberta, Edmonton.

The C.I.C. has recently published *Chemical Statistics in Canada*, a 40-page report of the latest statistical information on the chemical, petroleum chemical and chemical process industries, with charts, tables and a commentary (reprinted from *Chemistry in Canada*, June, 1960). New features include a description of how the Dominion Bureau of Statistics secures its information, and details of other sources of chemical statistics in Canada. Single free copies are available from the C.I.C., 48 Rideau Street, Ottawa 2, Ontario.

Linderstrøm-Lang Memorial.—An international group of scientists who were associates and friends of Professor K. A. Linderstrøm-Lang have assumed the task of collecting $150,000 to provide a guest house for visiting scientists who plan to work either in the Carlsberg Laboratories or in allied departments in the University of Copenhagen. It is hoped that there will be a central building for single persons, together with several smaller cottages for the housing of families. The Carlsberg Foundation has donated a sizeable sum, and various other industrial groups and private persons have indicated their willingness to contribute.

Professor Linderstrøm-Lang's contributions to biochemistry, particularly in the field of protein chemistry, were fundamental and far-reaching, and will continue to influence research for many years. His warm personality and his unique combination of wisdom and humour gave the Carlsberg Laboratories a special significance for the numerous workers who visited them.

Those wishing to contribute to the Memorial should communicate with Dr C. B. Anfinsen, chief of the laboratory of cellular physiology and metabolism, National Heart Institute, Bethesda, U.S.A.

Counties Public Health Laboratories.—The address of the office and laboratories of the Counties Public Health Laboratories (Thresh, Beale & Suckling) is now Thresh House, Verulam Street, Gray's Inn Road, London, W.C.1.

New Pakistan Refinery.—Kellog International Corporation, London, a subsidiary of the M. W. Kellog Co., New York, has been awarded a contract for the construction of a new refinery near Karachi for the Pakistan Refinery Ltd. The refinery will consist of a 34,000 barrel/day distillation unit, a catalytic reforming unit and a hydro-treater. There is also to be a marine terminal, and a pipeline from port to site.

Worshipful Company of Horners Award.—A prize of 100 guineas is offered to encourage young craftsmen in plastics. The award is administered by the British Plastics Federation, and is open to any resident of Great Britain and Northern Ireland who will be under 35 years of age on 2 December. The subject selected for competition is a design for production wholly or mainly in plastics materials. In assessing an entry decorated by embossing, engraving or laminating, the artistic merit of the decoration will be taken into consideration. Entries must be received by 2 December, and application forms and further details may be obtained from the British Plastics Federation, 47 Piccadilly, London, W.1.

Physical Society Colour Group.—Owing to the winding up of the Physical Society, the Colour Group is calling an Extraordinary General Meeting, to discuss the Group's future, at 3 p.m. on 23 November at Battersea College of Technology, S.W.11.

Obituary

Ernest Arthur Bearder. *B.* 24.12.1886. *Ed.* Central High School, Leeds; University of Leeds, 1905–09. He remained at the University for a further two years on postgraduate research. M.Sc. He then became research assistant to Professor A. G. Green at Manchester College of Technology. Subsequently he was appointed research and colour chemist, Wilton Research Laboratories, Manchester; research chemist, artificial silk department, British Cellulose Co. Ltd, Derby; dyestuffs adviser, Association of British Chemical Manufacturers; technical adviser, Dyestuffs Advisory Licensing Committee, Board of Trade; and departmental manager, Imperial Chemical Industries Ltd. For a time he was Director-General, Chemical Industry Branch, Control Commission for Germany. He returned to Imperial Chemical Industries Ltd, where he remained until his retirement, when he was a Delegate Director. He was appointed M.B.E. (*A.* 1918, *F.* 1924). *D.* 22.7.60.

Henry Gethin Davey. *B.* 26.12.08. *Ed.* University College, Cardiff, 1927–30. B.Sc. He remained at the College for a further two years as a research student and obtained the M.Sc. in 1932. The same year he was appointed lecturer in industrial chemistry and chemical engineering at the South Wales and Monmouthshire School of Mines. He left in 1940 on his appointment as a chemist in the Ministry of Supply, and was promoted to managing chemist in 1942. Six years later he became superintendent of the atomic energy factory at Sellafield. He was appointed O.B.E. in 1952. (*A.* 1932, *F.* 1944). *D.* 7.8.60.

Harold Claude Lockwood. *B.* 29.4.02. *Ed.* King's Norton Secondary School; Birmingham Technical College, 1919–27. B.Sc(Lond.). He joined the laboratory of Cadbury Bros Ltd in 1918, continuing his studies at the Day Continuation School, Bournville, and at Birmingham Technical College. In 1939, as a result of his work in investigations on trace substances in food products, he was awarded the Ph.D.(Lond.). He remained at Cadbury Bros Ltd until the time of his death, when he was senior research analyst. He was the author of a number of papers, a keen student of the arts and a member of the Bournville Arts Club, of which he later became chairman. (*A.* 1928, *F.* 1935). *D.* 14.8.60.

William Marsden. *B.* 3.11.02. *Ed.* Mickley School, Northumberland; Rutherford Technical College, Newcastle upon Tyne, 1919–24. B.Sc. (Leeds). He became a pupil of Dr J. T. Dunn, of J. & H. S. Pattinson, consulting chemists, in 1919. He was taken on the staff in 1923. He remained with the firm until the time of his death, when he was chief assistant analyst. (*A.* 1942). *D.* August, 1960.

Albert Edward Wallis. *B.* 10.12.1891. *Ed.* Regent Street Polytechnic, London. He became a research assistant and analyst in Dr Ludwig Mond's laboratories in 1907, and three years later was appointed chief chemist in Dr Robert Mond's laboratories. He was engaged in the Chemical Investigation Department, Ministry of Supply, 1915–19, afterwards returning to Dr Robert Mond's laboratories. He left in 1923 to join Henry Wiggin & Co. Ltd as a works and research chemist, being promoted to chief chemist in 1926. He joined the Mond Nickel Co. Ltd in 1932 as a research chemist, and remained until his retirement in 1953, when he was research manager of the Clydach Refinery. (*F.* 1932). *D.* 12.8.60.

Correspondence

How Does the Periodic Table Begin?

SIR,—If R denotes a typical univalent radical such as H or Cl or CH_3 or C_6H_5 or NH_2 or CN, there is nearly always similarity between the physico-chemical properties of RH and RCl when both are known, but never the slightest similarity between RH and RNa. To take one typical example, H_2 and HCl are gaseous molecules while NaCl is an ionic crystal. Admittedly, there is chemical similarity between the ions Na^+ and NH_4^+ and OH_3^+ but there is none whatever between Na^+ and H^+. Why then, even in recent versions of the periodic table, is hydrogen attached to the alkali metals instead of to the halogens where it rightfully belongs? The only explanation seems to be that the mistake was introduced nearly a century ago and no one has troubled to correct it.

E. A. GUGGENHEIM

Department of Chemistry,
University of Reading

The Extension of Institute Activities

SIR,—It seems reasonable to divide the activities of our profession broadly into learning and applying or extending knowledge. At present the Institute does a great deal to safeguard academic standards. It also ensures certain standards of professional conduct. It does not, however, do much to promote thought on how the chemist can most efficiently apply his knowledge or carry out research.

Nowadays much of a chemist's success can depend on his ability to work through others. This involves the organization of research or production teams and often requires the catalysis of creative thought and action in others. In order that we in this country can compete with the larger industrial units now being formed in the world —in the U.S.A., the European Common Market and Russia—it seems reasonable to suppose that we must

produce more ideas from a given group of people in a given time and act on them more quickly and efficiently.

There must be many senior members of the Institute who could contribute a great deal on these lines from their own experience. In addition, a general discussion of the issues might spur others to new lines of thought. May I suggest that this is a very necessary field of action in which members of the Institute could and should do much more than we do at present.

R. J. THOMPSON

66 Hillside Road,
Ashtead, Surrey.

THE REGISTER

NEW FELLOWS

(Y) BELL, Ronald Percy, M.A. (OXON.), F.R.S.
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(P) IRVING, Roger John, M.SC. (ADEL.), PH.D. (LEEDS)
LEIGH, William Richard Druce, M.SC. (SYD.)
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(E) CUMMINGS, William Allen Wesley, B.SC., PH.D.(DUNELM.)
(P) DENT, Kathleen Peggy
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(Q) NIXON, Norbert
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(WW) SIM, Alexander Kennedy, B.SC.(EDIN.)
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(Q) SMITH, Clifford
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(P) STEVENS, David John, B.SC.(R'DG)
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(J) SYME, Eric, A.H.-W.C.
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(D) THAYER, John Michael
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(SS) WILKINSON, Allan
(O) WILLIAMS, Brian Hugh
(R) WILSON, John Walter, D.L.C.

DEATHS

Fellows

(R) BOWLES, Percy Ewart, PH.D.(HEIDELBERG). Died 13 October, 1960, aged 77. *F.* 1918.

(P) BROOKER, James William George. Died 10 October, 1960, aged 80. *A.* 1903, *F.* 1907.

(P) COULSON-SMITH, Carl, M.SC.(DUNELM.). Died 23 July, 1960, aged 67. *A.* 1930, *F.* 1937.

(B) GIBSON, William Howieson, O.B.E., B.SC.ECON., D.SC.(LOND.). Died 28 July, 1960, aged 75. *A.* 1917, *F.* 1921.

(P) HELSBY, Frank Williams, B.SC., PH.D.(LOND.). Died 6 September, 1960, aged 62. *A.* 1922, *F.* 1951.

(OJ) KULANAYAGAM, Vallipuram. Died 13 August, 1960, aged 52. *A.* 1939, *F.* 1948.

MCRAE, John Alexander, M.A., LL.D.(QUEEN'S), PH.D., D.SC.(MANC.). Died April, 1960, aged 70. *A.* 1911, *F.* 1915.

MILLIN, David, B.A.(CAPE). Died 29 April, 1960, aged 69. *A.* 1914, *F.* 1918.

(P) MURRAY, Humphrey Desmond, M.A.(OXON). Died 2 August, 1960, aged 61. *A.* 1925, *F.* 1933.

(P) NEECH, Herbert Richard. Died July, 1960, aged 81. *A.* 1919. *F.* 1943.

(K) STEVEN, Alec Bowring, B.SC.(LOND.). Died 11 October, 1960, aged 83. *F.* 1918.

Associates

(P) ACLAND, Theodore William Gull, M.A.(CANTAB.). Died 13 October, 1960, aged 70. *A.* 1917.

(K) GRIMWADE, Michael, B.A., B.SC.(OXON). Died 13 October, 1960, aged 48. *A.* 1934.

(O) JONES, Clifford, B.SC.(LIV.). Died 21 July, 1960, aged 54. *A.* 1945.

(O) LEVY, Sydney Lionel, B.SC.TECH.(MANC.). Died 4 June, 1960, aged 59. *A.* 1947.

(J) MEIKLE, John, B.SC.(GLAS.). Died 10 September, 1960, aged 56. *A.* 1925.

(Y) NICHOLSON, Marcus Norman, B.SC.(GLAS.). Died 6 October, 1960, aged 64. *A.* 1924.

(X) REDFERN, William, B.SC.(SHEFF.). Died 8 October, 1960, aged 56. *A.* 1947.

(H) WELCH, Sidney Arthur, B.SC.(LOND.). Died 30 September, 1960, aged 70. *A.* 1918.

LOCAL SECTIONS OF THE INSTITUTE

DIARY OF MEETINGS

Sections are glad to welcome members of other Sections to their meetings and social functions, except when numbers are restricted, as for works visits. Those wishing to attend meetings outside their own area are advised to write to the Hon. Secretary of the Section concerned, as the Institute cannot accept responsibility for any alterations or cancellations. All times are p.m. except where otherwise stated. For key to Local Sections *see J.*, 346.

(A) **Aberdeen.** 14 Dec. 8. Rocket Propulsion. Dr C. H. Johnson. Robert Gordon's Technical College. Joint, C.S. and S.C.I.
—— 22 and 23 Dec. 3. Christmas Lectures for Senior Secondary School Pupils: The Ocean as a Background to Life. Life in the Ocean. Dr J. H. Fraser and Mr R. E. Craig. Chemistry Department, University

(T) **Bangor.** 8 Dec. 5.45. High-Temperature Oxidation of Metals. Dr S. J. Gregg

(B) **Belfast.** 13 Dec. 7.45. Catalytic Mechanisms of Hydrolytic Enzymes. D. T. Elmore. Chemistry Lecture Theatre, Queen's University, Stranmillis Road

(SS) **Burnley.** 24 Nov. 7.30. Hydrogen-Atom Abstraction Reaction by Free Radicals. Prof. F. S. Dainton. Municipal College

(P) **Cambridge.** 6 Dec. 7.45. Forensic Science. F. G. Tryhorn. University Chemical Laboratory, Lensfield Road

(C) **Coventry.** 7 Dec. 7. The Sorption of Water Vapour by Polymers. Dr L. Valentine. Technical College.

(H) **Derby.** 13 Dec. 7.30. Rocket Fuels. Dr W. G. S. Parker. Lecture Theatre, College of Art

(F) **Dublin.** 30 Nov. 7.45. The Safety-in-Use of Food Additives. Prof. A. C. Frazer. Trinity College

(FF) **Dundee.** 14 Dec. 3. Christmas Lecture for Senior Pupils: The Work of the Railway Chemist. Mr A. W. Fairgreave. Queen's College

(J) **Edinburgh.** 15 Dec. Film Evening. The Edinburgh Film Guild, 3 Randolph Crescent
—— 27 and 28 Dec. Christmas Lectures to Senior School Children

(W) **Exeter.** 14 Dec. 3. Christmas Science Lecture: Chromatography. Dr F. H. Pollard. Washington Singer Laboratories

(K) **Glasgow.** 1 Dec. 6.30 for 7. The Ramsay Dinner. Central Hotel. Joint, Federation of Chem. Socs in Glasgow
—— 2 Dec. 7.15. Address by R. C. Chirnside. Royal College of Science and Technology (Room 24). Joint, C.S., S.A.C., S.C.I.

(WW) **Grangemouth.** 7 Dec. 7.30. Ladies Evening. Alcohol, Antibiotics, Cows and Chemistry. Dr M. A. Pyke. Mahratta Restaurant

(L) **Huddersfield.** 1 Dec. 7.30. Recent Advances in Gas Chromatography. D. H. Desty. Alexandra Chambers, 32 John William Street. Joint, Coll. of Tech. Chem. Soc.

(M) **Hull.** 5 Dec. 7.15. The Role of Cytochrome C in the Autoxidation of Unsaturated Fatty Acids. Dr A. Banks. Royal Station Hotel. Joint, O.C.C.A. and S.C.I.

(G) **Ipswich.** 15 Dec. 7.30. Instrumental Methods of Chemical Analysis. G. F. Reynolds. Civic College

(C) **Keele.** 6 Dec. 8. Some Recent Developments in the Porphyrin Field. Prof. G. W. Kenner. University College of North Staffs.

(SS) **Lancaster.** 15 Dec. 7.30. Some Modern Reagents for Reduction Reactions. Prof. A. J. Birch. Technical College

(P) **London.** 8 Dec. 7. Aromatic Fluorine Compounds. Prof. M. Stacey. Northampton College of Advanced Technology, St John Street, E.C.1

(P) **Maidstone.** 13 Dec. 7.30. Photography in Scientific Research. K. G. Moreman. The Old Palace. Joint, Maidstone Photographic Society

(Q) **Manchester.** 7 Dec. 7. Chairman's Address. Dr L. R. Ridgway. College of Science and Technology

(S) **Newcastle.** 9 Dec. 7.30. Joint Chemical Societies' Annual Dinner Dance. County Hotel

(E) **Newport.** 7 Dec. 7. Radioactivity in relation to Water Supplies. F. P. Hornby. College of Technology, Allt-yr-yn. Joint, S.A.C. and S.C.I.

(W) **Plymouth.** 13 Dec. 3. Christmas Science Lecture: Chromatography. Dr F. H. Pollard. Technical College

(R) **Poole.** 13 Dec. 7.30. Agricultural Engineering. H. J. Hamblin. Poole Generating Station. Joint, Poole and District Technical Group

(R) **Portsmouth.** 2 Dec. 7. Non-Aqueous Titrations. G. F. Lewis. College of Technology. Joint, Portsmouth and District Chem. Soc.

(U) **Rotherham.** 14 Dec. 7. Semi-micro Analysis. H. Holness. College of Technology

(EE) **Seascale.** 2 Dec. 8. Ladies Evening. Some Aspects of the Work of a Research Association concerned with Foods. Dr D. Dickinson. Windscale Club

(R) **Southampton.** 5 Dec. 7.45. Social Evening: Film Show and Sherry Party. The University

(X) **Stockton.** 7 Dec. Exhibition of Films. Spark's Café, High Street

(EE) **Whitehaven.** 9 Dec. 5.45. Schools Lecture: Chemistry in Atomic Energy. J. K. Foreman. Technical College, Flatt Walks

(O) **Widnes.** 8 Dec. 7. Some Recent Advances in Polymer Chemistry. A. N. North. College of Further Education

HON. SECRETARIES

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(Q) Manchester and District	**R. Shackleton,** F.R.I.C., Magnesium Elektron Ltd, P.O. Box No. 6, Clifton Junction, Manchester
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